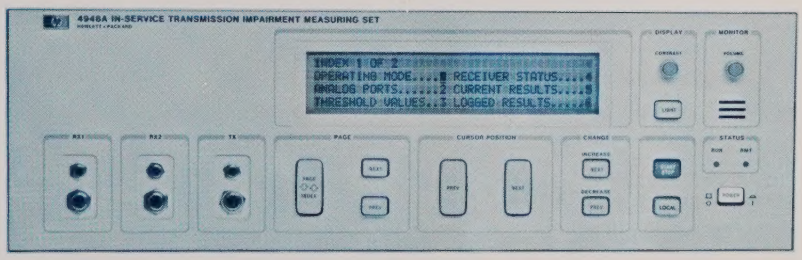
OPERATING MANUAL

4948A

IN-SERVICE TRANSMISSION IMPAIRMENT MEASURING SET



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CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

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HEWLETT PACKARD

OPERATING MANUAL

4948A

IN-SERVICE TRANSMISSION IMPAIRMENT MEASURING SET (Including Options 001 to 005)

SERIAL NUMBER

This manual applies directly to instruments with serial numbers prefixed 2615U.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section 5.

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SOUTH QUEENSFERRY, WEST LOTHIAN, SCOTLAND

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Printed: January 1987

WARNING

READ THE FOLLOWING NOTES BEFORE INSTALLING OR SERVICING ANY INSTRUMENT.

1. IF THIS INSTRUMENT IS TO BE ENERGIZED VIA AN AUTO-TRANSFORMER MAKE SURE THAT THE COMMON TERMINAL OF THE AUTO-TRANSFORMER IS CONNECTED TO THE NEUTRAL POLE OF THE POWER SOURCE.

2. THE INSTRUMENT MUST ONLY BE USED WITH THE MAINS CABLE PROVIDED. IF THIS IS NOT SUITABLE, CONTACT YOUR NEAREST HP SERVICE OFFICE. THE MAINS PLUG SHALL ONLY BE INSERTED IN A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD (POWER CABLE) WITHOUT A PROTECTIVE CONDUCTOR (GROUNDING).

3. THE SERVICE INFORMATION FOUND IN THIS MANUAL IS OFTEN USED WITH POWER SUPPLIED TO AND PROTECTIVE COVERS REMOVED FROM THE INSTRUMENT. ENERGY AVAILABLE AT MANY POINTS MAY, IF CONTACTED, RESULT IN PERSONAL INJURY.

4. BEFORE SWITCHING ON THIS INSTRUMENT:

   (a) Make sure the instrument input voltage selector is set to the voltage of the power source.

   (b) Ensure that all devices connected to this instrument are connected to the protective (earth) ground.

   (c) Ensure that the line power (mains) plug is connected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient).

   (d) Check correct type and rating of the instrument fuse(s).

5. SERVICING INFORMATION:

   (a) This manual contains information, cautions and warnings which must be followed to ensure safe operation and to retain the instrument in safe condition. Service and adjustments should be performed only by qualified service personnel.

   (b) Any adjustment, maintenance and repair of the opened instrument under voltage should be avoided as much as possible and, when unavoidable, should be carried out only by a skilled person who is aware of the hazard involved.

   (c) Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

   (d) Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

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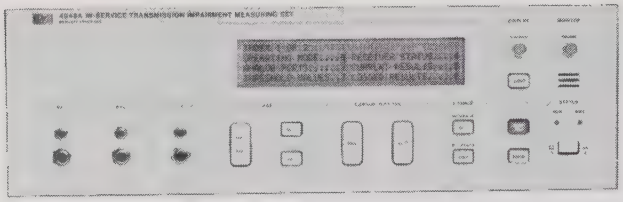
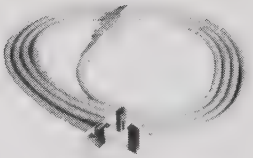
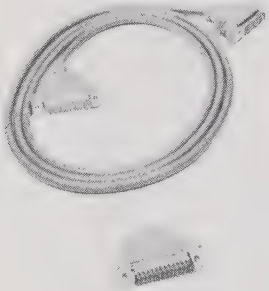
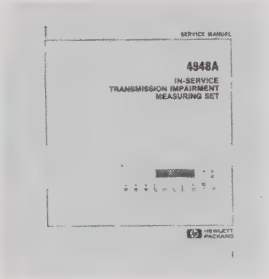
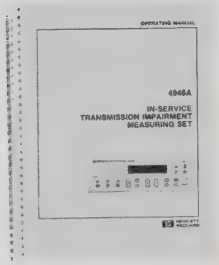
INITIAL INSPECTION











CONTENTS

In-Service Transmission Impairment Measuring Set
Power Cord
RS-232-C Cable
RS-232-C Test Plug
Service Manual
Operating Manual
Operating Instruction Label

WARNING

TO AVOID HAZARDOUS ELECTRICAL SHOCK, DO NOT PERFORM ELECTRICAL TESTS WHEN THERE ARE SIGNS OF SHIPPING DAMAGE TO ANY PORTION OF THE OUTER ENCLOSURE (COVERS, PANELS, METERS, ETC.).

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. Procedures for checking electrical performance are given in Section 4 of the Service Manual. If the contents are incomplete, if there is mechanical damage or defect or if the 4948A does not pass the Performance Tests, notify the nearest Hewlett-Packard office. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carriers inspection. The HP office will arrange for repair or replacement at HP option without waiting for claim settlement.

INSTRUMENT DESCRIPTION

The HP 4948A In-Service Transmission Impairment Measuring Set measures voice frequency (V.F.) telephone line impairments which affect data transmission. Traditionally these measurements have required the circuit under test to be taken out of service. As its name suggests the 4948A measures impairments without interrupting the service on the line.

Impairment parameters in telephone lines are divided into two groups.

- steady state
- transient

Steady State	Transient
frequency offset phase jitter amplitude jitter signal to noise ratio amplitude v frequency delay distortion v frequency signal level	dropouts phase hits amplitude hits impulse noise

The traditional method of measuring impairments is to take the test circuit out-of-service, transmit a "test signal" through the circuit, and measure the impairments by comparing the signal returned from the circuit under test with the original "test signal".

By contrast, the 4948A monitors "live" data and uses signal processing techniques to measure impairments (see Product Note 4948A-1 "Measurement Principles") on working circuits. In-service measurements can be made at any suitable V.F. access point on circuits carrying signals generated by compatible modems.

The 4948A can also transmit and/or receive a tone or can transmit a simulated modem signal for out-of-service testing.

Suitable Modems and Circuits

The 4948A is designed to operate with the most common types of leased line modems in the 2.4 - 9.6 kbit/s range, as detailed in Table A on Page 5-4. Many proprietary modems are compatible with these types when appropriately set.

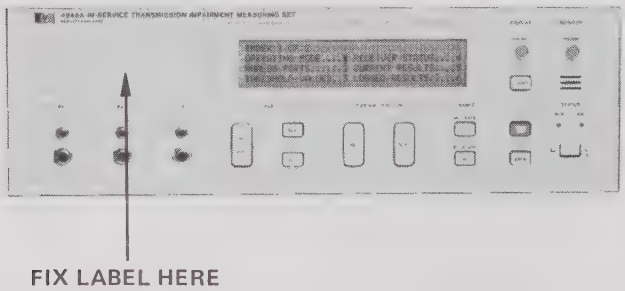
The 4948A can measure on random line signals present continuously for at least one minute, so it may be used in-service on point-to-point circuits or on the host-to-slave direction of multi-point circuits. It can also be used on slave-to-host circuits if a continuous signal is provided (for example, by loopback).

To allow in-service testing by the 4948A, circuits must carry a continuous, standard signal with standard scrambling. For further details, see Appendix B.

OPERATING INSTRUCTION LABEL

The Operating Instruction Label supplied with the instrument is a useful reminder of the instrument set-up procedure and is intended to be placed on the front panel to the left of the display.

If you want to fix the instruction label to the panel, remove the paper backing from the label to reveal the adhesive surface; place the label in position on the panel (see diagram below) and rub gently with a soft cloth.



Getting Started 1

Introduction

From switch-on, this section introduces you to front and rear panel features and shows by demonstration how easy the 4948A is to use.

The three demonstrations illustrate the following:

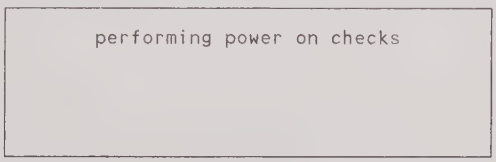
- in-service testing
- in-service testing with a hard copy of results
- a back-to-back single tone measurement

Instrument Switch-On

CAUTION

Before connecting the 4948A to the ac power source ensure that the rear panel VOLTAGE SELECTOR SWITCH is set for the power-line voltage to be used and that a fuse of the correct rating is installed (refer to INSTALLATION section).

Turn on the power to the 4948A by pressing the POWER switch to on (position 1). Verify that the cooling fan is operating and that the following message is displayed (with backlighting on).



Normally, after 15 seconds the backlighting goes off, the display changes to an INDEX and the 4948A assumes the stopped state (RUN led extinguished). The stopped state is the state the 4948A has to be in if you want to change instrument settings.

```
INDEX 1 OF 2
OPERATING MODE....1 RECEIVER STATUS....4
ANALOG PORTS......2 CURRENT RESULTS....5
THRESHOLD VALUES..3 LOGGED RESULTS.....6
```

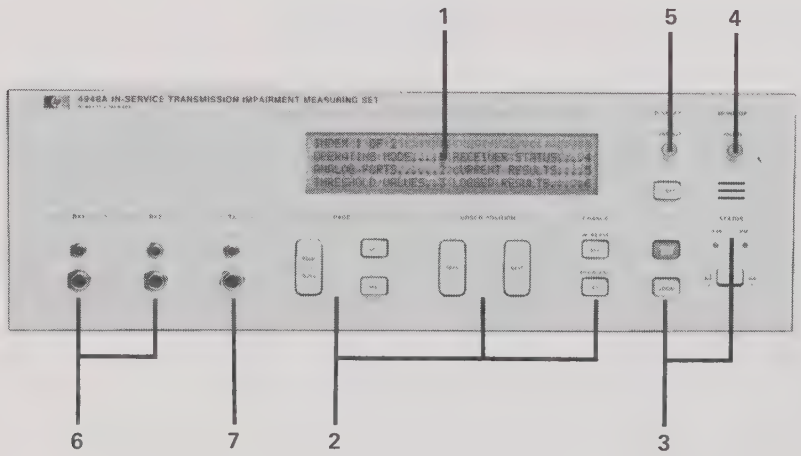
The 4948A may power up with the **RUN** led lit. If it does, press the **START/STOP** key twice to enter the stopped state.

The 4948A may also power up with a warning message (lasts for 10 seconds) before displaying the **INDEX** and lighting the **RUN** led.

```
WARNING: The HP4948A is configured to
auto-start and will TERMINATE THE LINE.
Remove any unwanted line connection NOW!
```

To enter the stopped state press the **START/STOP** key twice.

Front Panel Features



1 Information on instrument status, configuration and results is presented to you on pages on the 4948A display. The term page is used to describe a group of related items presented on the display.

After switch-on, the 4948A displays an index listing all available pages (see Page 1-3). The page order reflects the steps you would normally follow to set up and run a test.

```
INDEX 1 OF 2
OPERATING MODE....1 RECEIVER STATUS....4
ANALOG PORTS......2 CURRENT RESULTS....5
THRESHOLD VALUES..3 LOGGED RESULTS.....6
```

```
INDEX 2 OF 2
LOGGING CONTROL...7 REMOTE CONTROL....10
PRINT.............8 CLOCK SETUP.......11
PRINTER CONTROL...9
```

2 Changing the instrument operation or accessing information requires you to use the **PAGE, CURSOR POSITION** and **CHANGE** keys.

The **NEXT** and **PREV PAGE** keys step the display forward and back through the pages listed in the index. Holding the **PREV PAGE** key pressed always returns you to the index, by stepping back through the pages (see Page 1-6).

The **INDEX/PAGE** key alternates the display between the index and any page highlighted by the cursor (flashing black square). To display a page from the index, move the cursor to the page you want (numbered 1 to 11 on the index pages) using the **NEXT** and **PREV CURSOR POSITION** keys, then press the **INDEX/PAGE** key.

To move the cursor between changeable items on the display, use the **NEXT** and **PREV CURSOR POSITION** keys. All changeable items are preceded by a ▸. On the **INDEX** pages the cursor is positioned on the page number.

To change an item on the display use the **CHANGE** keys. Some numeric items (e.g. LEVEL and FREQUENCY) require you to move the cursor on to the digit you want to change.

NOTE

As only related items are displayed, changing an item may cause others to appear or disappear.

You can check or change settings whether the 4948A is started or stopped. However, if started, you cannot make changes which affect the operation of the 4948A, e.g. you cannot change the receiver or transmitter impedances while the 4948A is running a test. If you try, the display does not change and the 4948A makes an audible beep as a warning.

NOTE

Any invalid key action results in the 4948A making an audible beep.

3 Once the 4948A has been set to what you want, the test can be started by pressing the **START/STOP** key (the **RUN** led will light). Pressing **START/STOP** again stops the test.

If the 4948A is operating under remote control and the local lockout has not been turned on, you can return the 4948A to local front panel control by pressing **LOCAL** (the **RMT** led will extinguish). The **LOCAL** key will only operate with HP-IB.

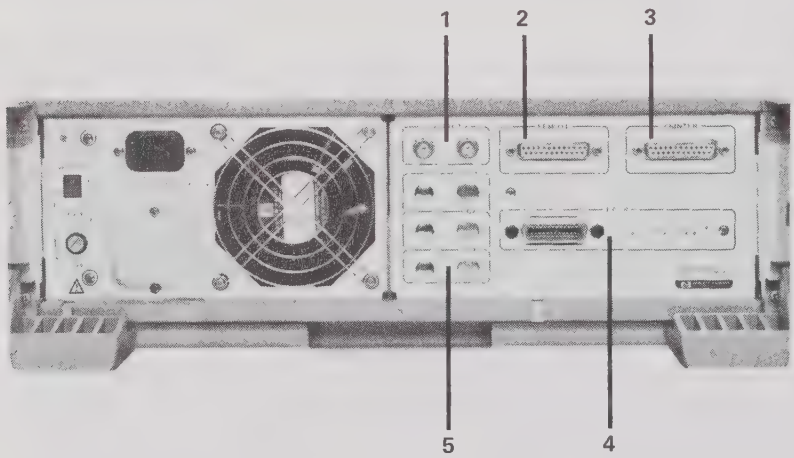
4 By listening to the audio MONITOR you can quickly confirm the expected signal types (tone test signal or VF modem signal). Adjust the audio level using the VOLUME control.

5 These controls should be adjusted to suit the prevailing light conditions. Set the contrast between the characters on the display and the background, by using the CONTRAST control. Backlighting can be added by pressing the LIGHT key. Backlighting automatically extinguishes 5 minutes after a front panel key is last pressed.

6 You can select either RX1 or RX2 as your receiver port (having two ports allows the 4948A to be connected directly to a 4-wire circuit). The port impedance is selectable, 600Ω or 900Ω which may be terminated or bridged. When the 4948A is not running a test, the receiver ports assume the bridged mode.

7 The TX transmitter port impedance is selectable, 600Ω or 900Ω. The transmitter source impedance is always present, whether the 4948A is running a measurement or stopped.

Rear Panel Features



1 When you want a two dimensional constellation diagram of the received modem signal in use, connect the X and Y inputs (dc coupled) of an oscilloscope to the X-Y OUTPUT. An analog oscilloscope is recommended for best real time viewing of impairments.

2 When you want to operate the 4948A remotely via the RS-232-C interface, connect a controller or terminal to the REMOTE CONTROL port.

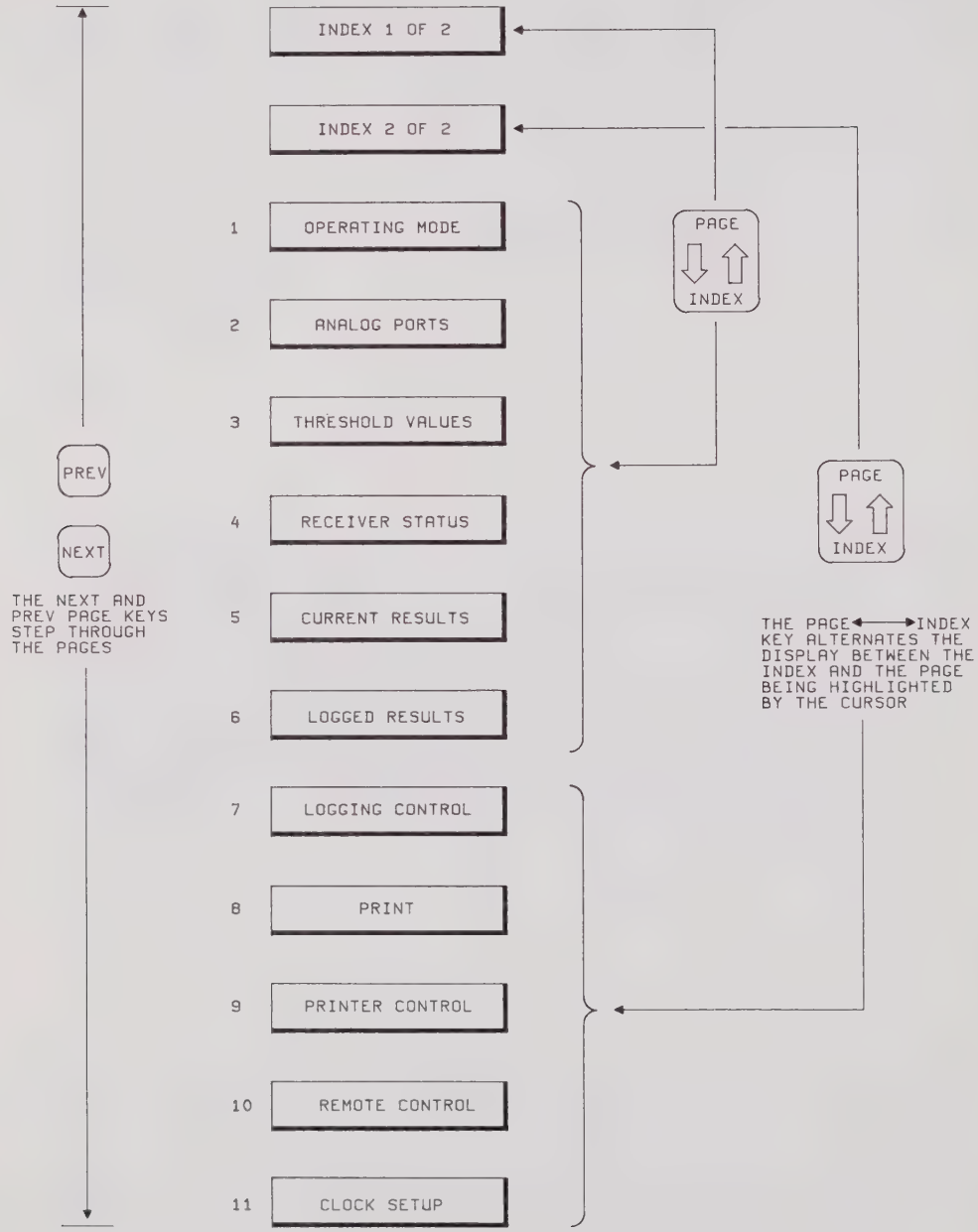
3 When you want a hard copy of results and you have an RS-232-C printer, connect the printer to the PRINTER OUTPUT port. The 4948A PRINTER control page must be set to RS232C.

4 When you want a hard copy of results and you have an HP-IB printer, connect the printer to the HP-IB port (the 4948A PRINTER control page must be set to HP-IB). The printer must be set to LISTEN ALWAYS before you power it up. The HP-IB port has a dual function, it can also be used to control the 4948A remotely (when it is in the Addressable mode). You cannot use the HP-IB port simultaneously for remote control and printing.

5 When the 4948A is either option 002 or 005 the RX1, RX2 and TX ports are rear panel mounted.

Using The Page Keys

The following diagram summarizes the use of the PAGE keys.



Demonstrating The 4948A

The following demonstrations show how easy the 4948A is to use.

Demonstration 1

This demonstration shows how you set up and run a test on a line carrying live data. If the 4948A receiver is set to **bridged**, it will not disturb the line.

NOTE

Check that the 4948A can operate on the modem signal you have available before proceeding with this demonstration (see Page 2-4)

Procedure	Page Ref
1. Display the OPERATING MODE page; select **receive modem signal** and set the MODEM SELECTION to **automatic**.	2-4

```
OPERATING MODE▸ receive modem signal.
MODEM SELECTION▸ automatic
```

2. Display the ANALOG PORTS page and set the port parameters to match your line.	2-7

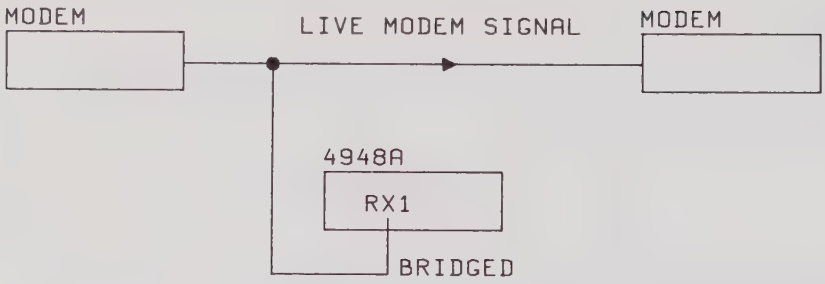
```
ANALOG PORTS
              INPUT▸ RX1
 RECEIVE IMPEDANCE▸ 600 Ω ▸ bridged
TRANSMIT IMPEDANCE▸ 600 Ω
```

3. Display the RECEIVER STATUS page; it will display the following message. Messages are preceded by a ♦ on the display.	2-10

```
RECEIVER STATUS
♦ receiver inactive
```

Procedure	Page Ref

4. Connect the 4948A to the circuit as shown below. 2-3



5. Press the **START/STOP** key (**RUN** led will light). The received modem signal can be heard on the audio **MONITOR** - adjust **VOLUME** control if required.

6. Before making measurements, the 4948A must identify the modem signal on the line (this may take several minutes). As identification progresses, messages are displayed on the **RECEIVER STATUS** page. When identification and training are complete, a message similar to the following is displayed. 2-10

```
RECEIVER STATUS
◆ all measurements available
◆ found 201B/C, V.26, V.27 fallback
```

7. Display the **CURRENT** page, then use the **CHANGE** keys to step through the results. A typical **signal level** result is shown below. 2-12

```
CURRENT▸ signal level

VALUE = -12.8 dBm
```

Demonstration 2

This demonstration shows how you set up and run a test on a line carrying live data and how you get a hard copy of the results using a printer.

CAUTION

Check that the 4948A can operate on the modem signal you have available before proceeding with this demonstration (see Page 2-4). The printer must be the only device connected to the 4948A HP-IB port.

An HP-IB printer is used in this demonstration. Ensure that the printer is set to LISTEN ALWAYS before powering it up (see Page 2-25).

Repeat steps 1 to 6 in Demonstration 1.

Getting Your Hard Copy of Results

	Procedure	Page Ref
7.	Connect the Printer to the HP-IB port on the rear panel.	1-5

NOTE

To get a hard copy of results via the HP-IB port, the 4948A PRINTER control must be set to HP-IB. The printer must be set to LISTEN ALWAYS and be the only device connected to the 4948A HP-IB port.

8.	Display the REMOTE control page and set it to RS232C. This ensures that you can configure the HP-IB port as a Printer Output as outlined in step 9.	2-25

```
REMOTE▸ RS232C                    ▸ part 1
CONNECTION▸ hardwired
ENQ/ACK▸ on              XON/XOFF▸ off
```

Procedure	Page Ref
9. Display the PRINTER control page and set it to HPIB.	2-25

```
PRINTER▸ HPIB

• printer must be set to LISTEN ALWAYS
```

10. Display the PRINT page, select current results and set PRINTING to on. When the current results printout is complete, the 4948A printer output is disabled, i.e. PRINTING changes from on to off.	2-27

NOTE

When PRINTING is set to on you cannot make changes to the 4948A which affect the printer control or what you want to print.

```
PRINT▸ current results


PRINTING▸ on    [use CHANGE key to stop]
```

```
CURRENT RESULTS                                              HP4948A

 9 Sep 1986 11:58:54

CURRENT STATUS
* all measurements available

          STEADY STATE MEASUREMENTS                    TRANSIENTS
                      value                          TIMER  00:01:17

sig level      -10.3 dBm                          phase hits      1
s/n ratio       34.5 dB                           gain hits       2
carr freq     1699.9 Hz                           impulses        1
phase mod        0.0 deg                          dropouts        1
ph jitter        0.8 deg                          ---------------------
ampl mod         0.0 %                                retrains    1
ampl jitt        0.8 %                        data rate changes   1
```

Demonstration 3

This demonstration, shows you how to make a single tone back-to-back measurement (i.e. with a looping cable connected between the RX1 and TX ports) using a level of -13dBm and a frequency of 1004Hz.

Procedure	Page Ref
1. Display the OPERATING MODE page; select transmit/receive tone and set the 4948A single tone parameters as shown below.	2-5

```
OPERATING MODE▸ transmit/receive tone
   TRANSMITTER▸ on
     FREQUENCY▸ 1004 Hz
         LEVEL▸ -13 dBm
```

2. Display the ANALOG PORTS page and set the port parameters as shown below. 2-7

```
ANALOG PORTS
              INPUT▸ RX1
 RECEIVE IMPEDANCE▸ 600 Ω ▸ terminated
TRANSMIT IMPEDANCE▸ 600 Ω
```

3. Display the RECEIVER STATUS page; it will display the following message. Messages are preceded by a ◆ on the display. 2-10

```
RECEIVER STATUS
◆ receiver inactive
```

4. Connect the RX1 input to the TX output. 1-2

5. Press the START/STOP key. The following is displayed. 2-7

```
WARNING: RECEIVER WILL TERMINATE LINE

         Press START again to start, or
         INDEX/PAGE to abandon
```

Procedure	Page Ref
6. Press START/STOP to start the test. (RUN led will light). The received tone signal can be heard on the audio MONITOR - adjust VOLUME control if required.	1-2
7. Before making measurements, the 4948A goes through a training process comprising several stages. As training progresses messages are displayed on the RECEIVER STATUS page. When training is complete, the following message is displayed.	2-10

```
RECEIVER STATUS
◆ all measurements available
```

8. Display the CURRENT page, then use the CHANGE keys to step through the results. A typical **signal level** result is shown below.	2-12

```
CURRENT▸ signal level

VALUE = -12.8 dBm
```

Testing With The 4948A 2

Introduction

This section presents the operating features in the order you would normally select them during testing. Use the "numbered tabs" to access the information you want e.g. if you want to know what receiver impedances are available, refer to tab 3.

Setting up the 4948A: Quick Ref

What can you do with the 4948A?

Matching the 4948A to the Line

Setting Thresholds

Receiver Status Messages

Reading Current Results

Period Logging

Event Logging

Printing Results

Setting the Real Time Clock 1

Setting up the 4948A: Quick Ref

When testing with the 4948A, the general procedure you should follow is given below.

- Remember the 4948A powers up with the configuration set by the last user.
- If the **RUN** led is lit after power-up, the 4948A is configured for data logging. Press the **START/STOP** key twice, if you want to exit the data logging mode.
- Display the pages in the order given below to set up and run a test:

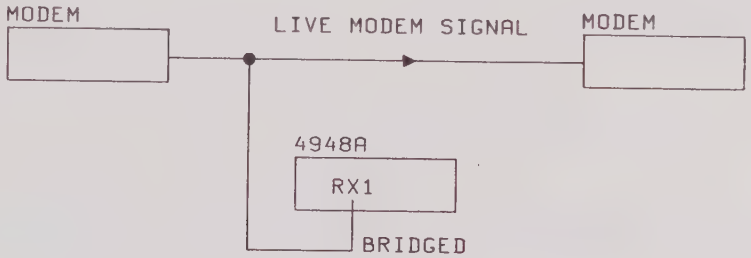
Page	Action
OPERATING MODE	Select the test Set level, frequency and modem type if transmitting Set to manual or auto configure if receiving a modem signal Select modem type if manual setting selected
ANALOG PORTS	Select the receiver port Set impedances for receiver and transmitter
THRESHOLD VALUES	Set transient thresholds Set alarm thresholds if event logging
RECEIVER STATUS, then press START key	See training in progress See warnings which affect measurements Adjust audio level to confirm expected signal type.
CURRENT	See the current results

- You only need to display the following pages if their functions are required for a particular test:

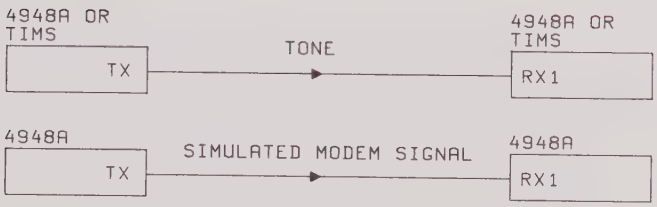
LOGGED	See results stored from an event or period logging test.
LOGGING	Set period or event logging Set period duration and time for a delayed start
PRINT	Select the information to be printed and then - Start printing
PRINTER	Select HP-IB or RS-232-C printer interface Set RS-232-C interface parameters
REMOTE	Set remote control interface parameters
CLOCK SETUP	Set time and date

What can you do with the 4948A?

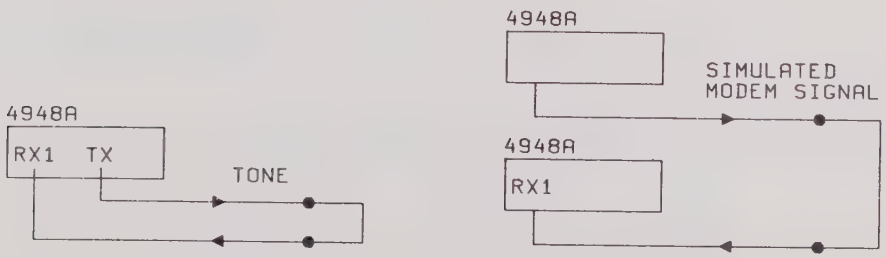
The 4948A can test lines which are in-service or out-of-service. If you are in-service testing, the 4948A makes measurements directly on a live modem signal, i.e. no line "down time". If you want to test lines which are out-of-service, you can use the 4948A to send and measure on a tone similar to a conventional transmission impairment measuring test set (TIMS) or you can use it to simulate a modem. Typical testing setups are shown below.



In-Service Testing



Out-of-Service Testing (end-to-end)



Out-of-Service Testing (loopback)

Suitable Modems and Circuits

The 4948A is designed to operate with the most common types of leased line modems in the 2.4 - 9.6 kbit/s range, as detailed in table A on page 5-4. Many proprietary modems are compatible with these types when appropriately set. The 4948A can measure on random line signals present continuously for at least one minute, so it may be used in-service on point-to-point circuits or on the host-to-slave direction of

multi-point circuits. It can also be used on slave-to-host circuits if a continuous signal is provided (for example, by loopback). To allow in-service testing by the 4948A, circuits must carry a continuous, standard signal with standard scrambling. For further details, see Appendix B.

To configure the 4948A for the test you want, display the **OPERATING MODE** page. There are three modes to choose from:

- receive modem signal
- transmit/receive tone
- tx simulated modem signal

NOTE

Two additional OPERATING MODES (Self-test and Service) are available, but not under normal operation. They are intended for service personnel. For further information see the Service Manual.

Receive Modem Signal

Select **receive modem signal** when you want to make in-service measurements.

```
OPERATING MODE▸ receive modem signal
MODEM SELECTION▸ automatic
```

MODEM SELECTION can be done **automatically** by the 4948A (if the modem signal type is not known) or **manually** by you (if the modem signal type is known). Manual selection saves time. For further details of suitable modems, see Appendix B.

```
OPERATING MODE▸ receive modem signal
MODEM SELECTION▸ manual
MODEM▸ 201B/C, V.26, V.27 fallback
```

In **manual**, the modem signals available are:

201B/C, V.26, V.27 fallback
208,2048, V.27 type
V.29 type
209 type
2096 type
V.29 (1800Hz) type

When **automatic** is selected the 4948A will make valid measurements if the modem signal on the line is one of those listed above.

Transmit/Receive Tone

Select **transmit/receive tone** for single tone out-of-service testing, for example to work with a conventional TIMS or other tone source. The 4948A can be configured as a receiver only, or as a transmitter and receiver.


```
OPERATING MODE▸ transmit/receive tone
   TRANSMITTER▸ off
```

Receiver only (transmitter off)

```
OPERATING MODE▸ transmit/receive tone
   TRANSMITTER▸ on
     FREQUENCY▸ 1004 Hz
         LEVEL▸  -13 dBm
```

Transmitter and Receiver

If **TRANSMITTER** is set to **off**, the 4948A functions as a receiver only. If set to on, the 4948A can both transmit and receive a tone and you can set the following transmitter parameters:

FREQUENCY in the range **400Hz** to **2810Hz**
LEVEL in the range **0dBm** to **-40dBm**

Tx Simulated Modem Signal

If you want to test a line using a modem signal and no modems are available, set the 4948A to **tx simulated modem sig.** A second 4948A, set to **receive modem signal**, is required to complete the test. The simulated modem signal contains no training sequence and therefore will not be recognized by a modem.

```
OPERATING MODE▸ tx simulated modem sig.

         MODEM▸ V.26 scheme A type
         LEVEL▸  -13 dBm
```

Select the **MODEM** signal you want to transmit from the following:

201 B/C type
V.26 scheme A type

```
V.26 scheme B type
208 type
2048 type
V.27 type
V.29 type
2096 type
209 type
V.29 (1800Hz) type
```


For details of these signals, see Table A on Page 5-4.

The transmitted **LEVEL** is in the range **0dBm** to **-40dBm**.

To prepare the 4948A for making a test turn to Page 2-7 "Matching the 4948A to the Line".

Matching the 4948A to the Line

The 4948A is matched to the line using the ANALOG PORTS page.

If you want to read or change the analog port conditions, display the ANALOG PORTS page.

```
ANALOG PORTS
              INPUT▸ RX1
 RECEIVE IMPEDANCE▸ 600 Ω ▸ terminated
TRANSMIT IMPEDANCE▸ 600 Ω
```

Select the receiver INPUT port you want, RX1 or RX2. (Having two ports allows the 4948A to be connected directly to a 4-wire circuit).

Set the RECEIVER IMPEDANCE to 600Ω or 900Ω and terminated or bridged.

Set the TRANSMIT IMPEDANCE to 600Ω or 900Ω.

CAUTION

If you are testing a line that is in service, ensure that the receiver port is set to bridged to prevent possible loading. A WARNING message is displayed when you run a test and the receiver is terminated..

```
WARNING: RECEIVER WILL TERMINATE LINE

         Press START again to start, or
         INDEX/PAGE to abandon
```

If you want to set Transient or Limit Alarm thresholds go to Page 2-8 "Setting Thresholds", otherwise proceed to Page 2-10 "Receiver Status Messages" to start the test.

Setting Thresholds

Setting threshold limits, to suit local line conditions, is a useful way of checking if the line signal is deteriorating. You can set threshold limits to whatever level you consider suitable when the 4948A is STOPPED, or when STARTED and not logging. You can set threshold values on transients or limit alarms.

NOTE

You cannot alter thresholds while running a test and logging. Threshold limits must be set before you start logging.

Transient Thresholds

Display the THRESHOLD VALUES page and select for transients.

```
THRESHOLD VALUES▸ for transients
   PHASE HITS▸  10°
    GAIN HITS▸   3 dB
IMPULSE NOISE▸ -12 dB w.r.t. signal
```

Set the THRESHOLD value for each impairment. Each time a transient threshold is exceeded the 4948A registers a count for that transient. The total count is displayed on the CURRENT▸ transients page.

Transient	Threshold Values Available
phase hits	10°, 15° or 20°
gain hits	1dB, 2dB, 3dB, or 6dB
impulse noise	0dB, -6dB, -12dB or -18dB

For default values, see Page 4-86.

The 4948A's impulse noise threshold is set as a ratio with respect to the received signal level, since it is this ratio which determines whether the impulses will cause data errors.

The 4948A threshold may be equivalenced to an absolute level - e.g. a -6dB threshold on a -13dBm signal is equivalent to 71dBrnC (or -19dBm).

For further information, refer to the impulse noise measurement specification (see Page 5-16), or the Product Note 4948A-1 "Measurement Principles".

Limit Alarm Thresholds

Limit alarm thresholds are normally set when using the **LOGGING EVENTS** feature of the 4948A. Each time a steady state impairment alarm limit is exceeded, a time and date stamped event is entered into the 4948A log. It will not record again, unless the value has first returned inside the limit by more than the hysteresis margin. The margins are defined in the "measurement specifications" (see Pages 5-10 to 5-14). You can then access the logged events via the display or a printer.

Set limit alarms by displaying the **THRESHOLD VALUES** page and select **for limit alarms**. A typical **upper signal level** display is shown below.

```
THRESHOLD VALUES▸ for limit alarms

ALARM▸ upper signal level
THRESHOLD▸  -12 dBm
```

Select the **ALARM** you want, then set the **THRESHOLD** value.

Alarm	Threshold Values
upper signal level	-1dBm to -48dBm *
lower signal level	-2dBm to -49dBm *
signal/noise ratio	18dB to 38dB
upper carrier frequency	402Hz to 2809Hz *
lower carrier frequency	401Hz to 2808Hz *
phase modulation 20-300Hz	4° to 30°
phase jitter 4-20Hz	4° to 30°
amplitude modulation 20-300Hz	4% to 20%
amplitude jitter 4-20Hz	4% to 20%

* The upper and lower thresholds can not overlap. For example, if the upper signal level threshold is set to -9dBm then the maximum value which may be set for the lower threshold is -10dBm. The maximum range between thresholds is 48dB.

You are now ready to start the test - turn to Page 2-10 "Receiver Status Messages".

Receiver Status Messages

When you press the START/STOP key to start the test you can use the audio MONITOR to quickly confirm the expected signal type (tone test signal or V.F. modem signal). Adjust the VOLUME control if required.

Once a test is started you can track its progress on the RECEIVER STATUS page until ◆ **all measurements available** appears, before moving on to look at results.

Alternatively, since the results displays also indicate ◆ **status!** when results are not yet available or not valid, you can go directly to the results displays, see Page 2-12. In this way you can see results as soon as they become available: some results are available earlier than others. Finally, when all results are available and valid, ◆ **status!** will disappear.

Using the RECEIVER STATUS Page

If the 4948A is in the **tx simulated modem sig.** mode, no receiver status messages are displayed. In the other modes, messages are as follows.

Before you run a test, the message displayed is:

```
RECEIVER STATUS
◆ receiver inactive
```

After the START/STOP key is pressed, the 4948A will display some of the following messages in turn:

- ◆ receiver inactive
- ◆ autoranging
- ◆ autoranging, signal too low
- ◆ autoranging, signal too high
- ◆ autoranging, no in-band signal
- ◆ receiver training stage 1
- ◆ receiver training stage 2
- ◆ training, check current results status
- ◆ all measurement available
- ◆ trained, check current results status

Key to Status Messages

`Receiver inactive` means the 4948A is idle. To start measurement - press the START/STOP key.

`Autoranging` or `receiver training stages 1/2` means the 4948A is adjusting to the received signal. Stage 1 normally takes only a few seconds. Stage 2 normally takes about a minute.

`Signal too high` may mean the signal must be measured through an attenuator. This message appears if the average signal level is above 1dBm.

`Signal too low or intermittent signal` may indicate a bad connection. The audio monitor may help identify the problem.

`No in-band signal` means there is an interfering signal outside the receiver bandwidth which is preventing the 4948A seeing the test signal. The audio monitor may help identify the problem.

When you start a test with the 4948A in the `receive modem signal` mode, the display will also show a `trying` or `found` message (e.g. `trying V.29 type`).

`Trying` indicates the 4948A is checking the line signal to see if it matches the type selected or as part of its automatic identification process. When the 4948A identifies the signal, `trying` changes to `found.` (The `trying` and `found` messages also appear on the OPERATING MODE page.)

A typical RECEIVER STATUS page is:

```
RECEIVER STATUS
◆ all measurements available
◆ found 201B/C, V.26, V.27 fallback
```

Reading Current Results

The 4948A displays one measurement result at a time (there are eleven measurements in all). To display all the results, follow the steps below.

1. Display the **CURRENT** page. A typical **CURRENT▶ signal level** result display is shown.

2. Use the **CHANGE** key to scroll through the list which follows:

```
signal level
signal/noise ratio
carrier frequency
phase modulation 20-300Hz
phase jitter 4-20Hz
amplitude modulation 20-300Hz
amplitude jitter 4-20Hz
data spectrum
transients
instrument retrains
data rate change
status
```

If **•status!** is displayed, you should check the **CURRENT▶ status** page. For information about the progress of the test or the validity of the results, see Page 2-13.

You may also see dashes (-) and/or asterisks (*) on the display:

a) If dashes (-) appear, the measurement result is not yet available.
b) If asterisks (*) appear, the measurement is not applicable for the currently selected 4948A operating mode.

If you operate the 4948A as a transmitter only (**tx simulated modem sig.**), no information may be read from the **CURRENT** page.

CURRENT▸ Status Page

Results are warranted if the display shows **all measurements available**. An explanation of the messages is on Page 2-14.

A normal progress of messages is:

- receiver inactive
- autoranging
- receiver training stage 1
- receiver training stage 2
- all measurement available
- all measurements available
- fallback

Conditions which may delay or prevent training are:

- autoranging
- signal too low
- receiver training stage 1
- wrong sig. type/excessive impairments
- may not complete training

- autoranging
- signal too high
- receiver training stage 1
- intermittent signal
- may not complete training

- autoranged
- no in-band signal
- receiver training stage 2
- excessive transients
- may not complete training

Conditions which may hinder measurements are:

- receiver trained
- carrier offset
- results uncalibrated

- receiver trained
- timing offset
- results uncalibrated

- receiver trained
- non random data
- results uncalibrated

Combinations of these messages may occur.

Key to Status Messages

Receiver inactive means the 4948A is idle. To start measurement - press the **START/STOP** key.

Autoranging or **receiver training stages 1/2** means the 4948A is adjusting to the received signal. Stage 1 normally takes only a few seconds. Stage 2 normally takes about a minute.

Signal too high may mean the signal must be measured through an attenuator. This message appears if the average signal level is above 1dBm.

Signal too low or **intermittent signal** may indicate a bad connection. The audio monitor may help identify the problem.

No in-band signal means there is an interfering signal outside the receiver bandwidth which is preventing the 4948A seeing the test signal. The audio monitor may help identify the problem.

Wrong signal type means the 4948A cannot identify the line signal. Check the modem selection is correct. Try using the automatic selection. The audio monitor may help identify the problem.

Excessive impairments means the signal is too distorted to train on.

Carrier offset means the modem carrier has a frequency error greater than 10Hz compared with what is expected. This may be due to an error in the modem frequency shift in the transmission channel, or because the modem modulation scheme is not quite standard.

Timing offset means the modem baud rate has an error greater than about 150ppm.

Non-random data means the line signal is not random enough for accurate measurements. This may arise if fixed data is sent using a modem without a scrambler (e.g. V.26 or 201 Type).

Fallback indicates the received modem signal is in a fallback state. This does not affect measurement.

Period Logging

When to use Period Logging

Period logging enables you to:

- Assess a circuits complete performance over a period of time (bench mark statistics).
- Correlate impairments to trace the cause of intermittent high error rates on critical circuits.

The 4948A can store up to 200 period entries. The period duration is selectable: 5, 15, 30 or 60 minutes. If you select 60 minutes, it will take over a week before the log is full (200 x 60 minutes). When the log is full the oldest entry is overwritten by the newest.

By reducing the period duration (from say 60 to 5 minutes) you can more accurately determine when impairments are occurring and which ones are coming together - all information that will help you trace the source of your fault.

Each entry contains the result (maximum, minimum and average value) for each measurement.

NOTE

Delay and attenuation distortion (DATA SPECTRUM) do not normally vary much over short periods, so these are not logged.

You can leave the 4948A unattended, monitoring a circuit, and at any time have a record of all the impairments for the previous 200 periods. When unattended it is safe from power failures - it saves all results when the power fails and continues to run the log when the power returns.

Setting up the 4948A for Period Logging

Before you log results the Real Time Clock must be set (see Page 2-42).

The 4948A logging functions are set via the LOGGING page. Points to consider before you begin period logging are:

- What period duration do you want (5, 15, 30 or 60 minutes)?
- Do you want to begin logging from the start of a test, or from some specific time during the test?

Setup Procedures

1. Display the LOGGING page and ensure LOGGING▶ setup is displayed.

2. Display LOG▶ periods of DURATION▶ MM, where MM is the current period duration setting in minutes.

3. Select the DURATION you want (5, 15, 30 or 60 minutes).

4. To begin logging from the start of the test, display LOG FROM▶ start. Alternatively, to begin logging from some specific time during the test, display LOG FROM▶ time▶ HH:MM, where HH:MM is the start time in hours and minutes. Change HH:MM to the time you want. Typical period logging setups are shown on the displays below:

```
LOGGING▶ setup
    LOG▶ periods of DURATION▶  5 minutes
LOG FROM▶ start
      TIME NOW = 13:35:47
```

Start logging from start of test

```
LOGGING▶ setup
    LOG▶ periods of DURATION▶  5 minutes
LOG FROM▶ time ▶ 07:00
      TIME NOW = 13:35:38
```

Start logging during test

5. Press the START/STOP key. One of two messages will be displayed.

```
WARNING: EXISTING DATA LOG WILL BE LOST

         Press START again to start, or
         INDEX/PAGE to abandon
```

If the existing log is of interest to you and you have not already checked it, do so now before starting the next log.

```
WARNING: RECEIVER WILL TERMINATE LINE
WARNING: EXISTING DATA LOG WILL BE LOST
         Press START again to start, or
         INDEX/PAGE to abandon
```

This display repeats the message about the log being lost and also tells you that the 4948A will terminate the line. If you are in-service testing, this could cause loading which may induce errors in the live data. Therefore, if you want to do in-service testing, change the receiver termination to bridged before starting the log.

6. Press the START/STOP key. A status message is displayed at the top right corner of the display.

```
LOGGING▸ setup                ◆ autosearch
   LOG▸ periods of DURATION▸ 15 minutes
LOG FROM▸ start
     TIME NOW = 13:41:14
```

Autosearch is displayed when the 4948A is in the **receive modem signal (automatic search)** mode. Logging will begin when the 4948A identifies the modem signal.

```
LOGGING▸ setup                ◆ waiting
   LOG▸ periods of DURATION▸  5 minutes
LOG FROM▸ time ▸ 14:00
     TIME NOW = 13:40:16
```

Waiting is displayed in the **LOG FROM▸ time** mode. Logging will begin from the time displayed on line 3.

```
LOGGING▸ setup                ◆ active
   LOG▸ periods of DURATION▸  5 minutes
LOG FROM▸ start
     TIME NOW = 13:39:30
```

Active normally indicates logging is in progress.

7. View the results (see Page 2-12) while the log is running or stopped. Information on when the log started and how many periods have been logged is contained on the **LOGGING▸ summary** page.

```
LOGGING▸ summary              ◆ active
LOG START = 8th Oct 1986  14:04:52

PERIODS LOGGED = 7
```

NOTE

When you are logging and you press the START/STOP key the following message is displayed.

```
WARNING: THE INSTRUMENT IS DATA LOGGING

        Press STOP again to stop, or
        INDEX/PAGE to continue
```

If you stop the log, it is recommended you either check the log or get a hard copy using a printer, as the log is cleared the next time a new log is set up and run.

Reading the Period Log on the Display

You can access all recorded periods one at a time.

The logged information is read on the LOGGED page by either selecting a period and reading all the measurements or by selecting a measurement and viewing it over a number of periods. In most instances it is recommended that you print out the period log. All results can be seen over a number of periods making analysis easier.

NOTE

Delay and attenuation distortion (DATA SPECTRUM) do not normally vary over short periods, so these results are not logged.

To read the log on the display:

1. Display the LOGGED page.

2. You can view the log by looking at all the measurement results for a particular period, by:

   a) Selecting the period you want on line 4 of the display.
   b) Re-position the cursor on line 1 of the display then scroll the results.

Alternatively, you can view a particular measurement over a number of periods, by:

   a) Selecting the measurement you want on line 1 of the display.
   b) Position the cursor on line 4 of the display and scroll the periods of interest.

A typical display (signal level) below shows the AVERAGE, MAX and MIN values recorded 6 periods ago.

```
LOGGED▸ signal level
                        MAX. =  -6.9 dBm
AVERAGE =  -6.9 dBm     MIN. =  -6.9 dBm
▸    6 periods ago at 06:34:46
```

Listed below are all the measurements available.

```
signal level
carrier frequency
phase modulation 20-300Hz
phase jitter 4-20Hz
amplitude modulation 20-300Hz
amplitude jitter 4-20Hz
transients
instrument retrains
data rate changes
```

You may also see that dashes (-) or asterisks (*) replace numeric values on the display.

a) If dashes (-) appear, all measurement results are not available.

b) If asterisks (*) appear, the measurement is not valid for the current 4948A operating mode.

If `•status!` appears, at the bottom right hand corner of the display, display the `LOGGED▸ status` page to find out why. Three displays contain the status information.

```
LOGGED▸ status ▸ miscellaneous
PERIOD START = 8th Oct 1986  14:04:52
LOGGED FOR  0 % OF PERIOD
▸   3 periods ago at 14:04:52
```

`miscellaneous`

The percentage value indicates the fraction of the normal period length for which result averaging took place. Should the percentage (%) value be less than 100, check the `status▸ warnings part 1` and `status▸ warnings part 2` pages. The value will be less than 100% if there is a power failure (`Pf/Cl`) or if you stop the log (`stop`).

```
LOGGED▸ status ▸ warnings part 1
Pf/Cl SigLo SigHi NoSig Wsig/ExIm IntSig
  □     □     □     □       □       □
▸   3 periods ago at 14:04:52
```

`warnings part 1`

```
LOGGED▸ status ▸ warnings part 2
Train FBack NRnd Timeoff CarrOff Stop
  □     □     □     □       □      □
▸   3 periods ago at 14:04:52
```

`warnings part 2`

The mnemonics which can appear on the display are explained below.

Mnemonic	Description
Pf/Cl	Power failure or device clear during period.
SigLo	Receiver unable to train - signal too low.
SigHi	Receiver unable to train - signal too high.
NoSig	Receiver unable to train - no signal in receiver bandwidth.*
WSig/ExIm	Signal type does not match selected modem. OR impairments are excessive.*
IntSig	Intermittent signal.
Train	Receiver training.
FBack	Fallback constellation.
NRnd	Data is non random.*
Timeoff	Timing offset.*
CarrOff	Carrier offset.*
Stop	Logging has been stopped by the operator. This period did not run its full length.
▪	Indicates that one of above has occurred.
>	Greater than.
<	Less than.
~	Approximate period average (ie max and min range for result have been violated.)

* See Page 2-14 for explanations of these messages.

Power Fail Recovery while Period Logging

The 4948A stores the log in continuous memory. If the 4948A is powered down or if there is a power failure, the log is preserved. When the 4948A next powers up, it automatically continues logging (indicated by the **RUN** led being lit when the power returns).

If the 4948A receiver is **terminated**, the following message is displayed (for 10 seconds) after power up, then the 4948A automatically continues logging.

```
WARNING: The HP4948A is configured to
auto-start and will TERMINATE THE LINE.
Remove any unwanted line connection NOW!
```

Event Logging

When to use Event Logging

Event Logging enables you to:

- Do routine monitoring on circuits with known performance limits - by setting threshold limits on each impairment.
- Accurately time stamp the occurrence of any violation of any of the impairment threshold limits - making it easy for you to trace the fault.

Up to 1000 events can be recorded, once the log is full the oldest entry is overwritten by the newest.

You can leave the 4948A unattended, monitoring a circuit, and at any time have a record of the previous 1000 events. When unattended it is safe from power failures - it saves all events when the power fails and continues to log when the power returns.

The log records the occurrence of the following:

out-of-limit alarms on steady state measurements
dropouts
gain hits
phase hits
impulse noise
retrains
data rate changes
power fail
power recovery

To set alarm and transient thresholds, see SETTING THRESHOLD on Page 2-8. Changes to the 4948A or to the properties of the line signal can also trigger "events" (e.g. changes in data rate). A time stamped "event" is recorded for every one-second interval containing one or more of the above.

Setting up the 4948A for Event Logging

Before you log results the Real Time Clock must be set (see Page 2-42).

Setup Procedure

1. Display the THRESHOLD VALUES page, then set the `limit alarm` of interest and widen the limits on the rest (see Page 2-8).
2. Display the LOGGING page and ensure LOGGING▶ `setup` is displayed.
3. Display LOG▶ `events`.

4. Press the START/STOP key. One of two messages will be displayed.

```
WARNING: EXISTING DATA LOG WILL BE LOST

         Press START again to start, or
         INDEX/PAGE to abandon
```

If the existing log is of interest to you and you have not already checked it, do so now before starting the next log.

```
WARNING: RECEIVER WILL TERMINATE LINE
WARNING: EXISTING DATA LOG WILL BE LOST
         Press START again to start, or
         INDEX/PAGE to abandon
```

This display repeats the message about the log being lost and also tells you that the 4948A will **terminate** the line. If you are in-service testing, this could cause loading which may induce errors in the live data. Therefore, if you are going to do in-service testing, change the receiver termination to **bridged** before starting the log.

5. Press the START/STOP key. A status message is displayed at the top right hand corner of the display.

```
LOGGING▸ setup                ♦ autosearch
   LOG▸ events

     TIME NOW = 07:39:41
```

Autosearch is displayed when the 4948A is in the **receive modem signal (automatic search)** mode. Logging will begin when the 4948A identifies the modem signal.

```
LOGGING▸ setup                ♦ active
   LOG▸ events

     TIME NOW = 07:40:10
```

Active normally indicates logging is in progress.

6. View the results (see Page 2-12) while the log is running or stopped. Information on when the log started and how many events have been logged is contained on the **LOGGING▸ summary** page.

```
LOGGING▸ summary
LOG START =  9th Oct 1986  07:40:05
LOG STOP  =  9th Oct 1986  07:40:39
EVENTS LOGGED =    2
```

NOTE

When you are logging and you press the START/STOP key the following message is displayed.

```
WARNING: THE INSTRUMENT IS DATA LOGGING

        Press STOP again to stop, or
        INDEX/PAGE to continue
```

If you stop the log, it is recommended you either check the log or get a hard copy using a printer, as the log is cleared the next time a new log is set up and run.

Reading the Event Log on the Display

The log is displayed on the LOGGED page. For each event the log is made up of three sections.

- steady state impairment out-of-limits alarm indicators
- transient counts
- receiver status

There is a separate display for each section. A typical example of each display follows:

```
LOGGED▸ alarms          ▸    2 events ago
EVENT TIME =  9th Oct 1986  07:41:30
   LEV  S/N  FRQ  PHM  PHJ  AMM  AMJ
    –    –    –    –    –    –    –
```

steady state impairment alarms

```
LOGGED▸ transients      ▸    2 events ago
EVENT TIME =  9th Oct 1986  07:41:30
   PHH   GNH   IMP   DPO   RTR   DRC
    0     0     0     0     0     *
```

transient counts

```
LOGGED▸ status          ▸    2 events ago
EVENT TIME =  9th Oct 1986  07:41:30
EVENTS LOGGED =    2
• autoranging
```

receiver status

The mnemonics and symbols which may appear on the displays are in the tables which follow.

Alarms		Transients	
Mnemonic	**Description**	**Mnemonic**	**Description**
LEV	Signal level	PHH	Phase hits
S/N	Signal to noise ratio	GNH	Gain hits
FRQ	Carrier frequency	IMP	Impulse noise
PHM	Phase modulation	DRO	Dropout
PHJ	Phase jitter	RTR	Instrument retraining
AMM	Amplitude modulation	DRC	Data rate change
AMJ	Amplitude jitter		

Symbol	Meaning
*	Result not applicable
-	Result not yet ready
>	Greater than
<	Less than
L	Lower threshold violated
U	Upper threshold violated

Power Fail Recovery while Event Logging

The 4948A stores the log in continuous memory. If the 4948A is powered down or if there is a power failure, the log is preserved. When the 4948A next powers up, it automatically continues logging (indicated by the **RUN** led being lit when the power returns.)

If the 4948A receiver is **terminated**, the following message is displayed (for 10 seconds) after power up, then the 4948A automatically continues logging.

```
WARNING: The HP4948A is configured to
auto-start and will TERMINATE THE LINE.
Remove any unwanted line connection NOW!
```

Printing Results

A hard copy of results which are time and date stamped can be obtained from the 4948A if you have a printer available. The printer can be either HP-IB or RS-232-C controlled. The 4948A has a printer output for each, on the rear panel (see REAR PANEL FEATURES on Page 1-4).

Using an HP-IB Printer

Formatting assumes 80-columns and 66-lines per page.

NOTE

Before switching the printer on, it must be set to LISTEN ALWAYS. The printer must be the only device connected to the 4948A HP-IB port.

When you want to use an HP-IB printer, you must access the REMOTE control page and ensure HP-IB is NOT selected, i.e. set remote control to RS232C. This is due to the rear panel HP-IB port having a dual function: it is either the HP-IB Remote Control port or the HP-IB Printer Output port (it cannot be both).

```
REMOTE▸ RS232C                    ▸ part 1
CONNECTION▸ hardwired
ENQ/ACK▸ on              XON/XOFF▸ off
```

NOTE

The complexity does not arise with an RS-232-C printer as the 4948A has separate RS-232-C Remote Control and Printer Output ports on the rear panel.

The PRINTER control page allows you to configure the 4948A for either an HP-IB or RS-232-C printer.

Display the PRINTER control page and set it to HPIB.

Using an RS-232-C Printer

Formatting assumes 80-columns and 66-lines per page.

NOTE

You must match the 4948A to the RS-232-C printer. You must also know the data rate, handshake, parity and number of stop bits of the printer before you can configure the 4948A.

Display the PRINTER control page and set it to RS232C.

```
PRINTER▸ RS232C
SPEED▸ 1200bps
HANDSHAKE▸ DTR
7 BIT DATA,  PARITY 1's     STOP BITS▸ 1
```

NOTE

If the REMOTE CONTROL page is set to HP-IB the PRINTER control page will automatically be set as below:

```
PRINTER◆ RS232C, remote control HP-IB
SPEED▸ 1200bps
HANDSHAKE▸ DTR
7 BIT DATA,  PARITY 1's     STOP BITS▸ 1
```

The data rate SPEEDs you can select are:

110 bps (bits per sec)
150 bps
200 bps
300 bps
600 bps
1200 bps
1800 bps
2400 bps

The choice of HANDSHAKE is:

DTR
XON/XOFF
ENQ/ACK

More information on the handshake is contained on Page 3-17.

Select PARITY from the following: 0's, 1's, odd or even.

Select STOP BITS from 1 or 2.

Printing Procedure

1. Set up the 4948A for the printer you have (HP-IB or RS-232-C).

2. The PRINT page allows you to select what you want to print and also allows you to enable printing.

```
PRINT▸ current results

PRINTING▸ off  [use CHANGE key to print]
```

You can PRINT:

current results
current data spectrum results
current measurement settings
past logged results
from now on, as results are logged

To print past logged results, the 4948A logging function must be off, otherwise the following message is displayed.

```
PRINT▸ logged results

◆ stop measurements to print
```

A hard copy of results is obtained when PRINTING is set to on.

NOTE

When PRINTING is set to on, you cannot change items on the PRINT and PRINTER control pages; if you try, a warning beep sounds. PRINTING must be set to off if you want to change anything on these pages.

Except in the special case of as results are logged, PRINTING automatically reverts to off when printing of the requested option has been completed.

Alternatively, PRINTING may be set to off manually by using the CHANGE keys. The print in progress will then be aborted and the printer will advance to the top of the next page.

3. Example print outs follow.

Current Results (sample print)

```
CURRENT RESULTS                                                    HP4948A

 9 Sep 1986 11:58:54

CURRENT STATUS
* all measurements available

          STEADY STATE MEASUREMENTS                    TRANSIENTS
                      value                          TIMER  00:01:17

sig level      -10.3 dBm                          phase hits      1
s/n ratio       34.5 dB                           gain hits       2
carr freq     1699.9 Hz                           impulses        1
phase mod        0.0 deg                          dropouts        1
ph jitter        0.8 deg                         ------------------
ampl mod         0.0 %                            retrains        1
ampl jitt        0.8 %                      data rate changes     1
```

Data Spectrum (sample print)

NOTE

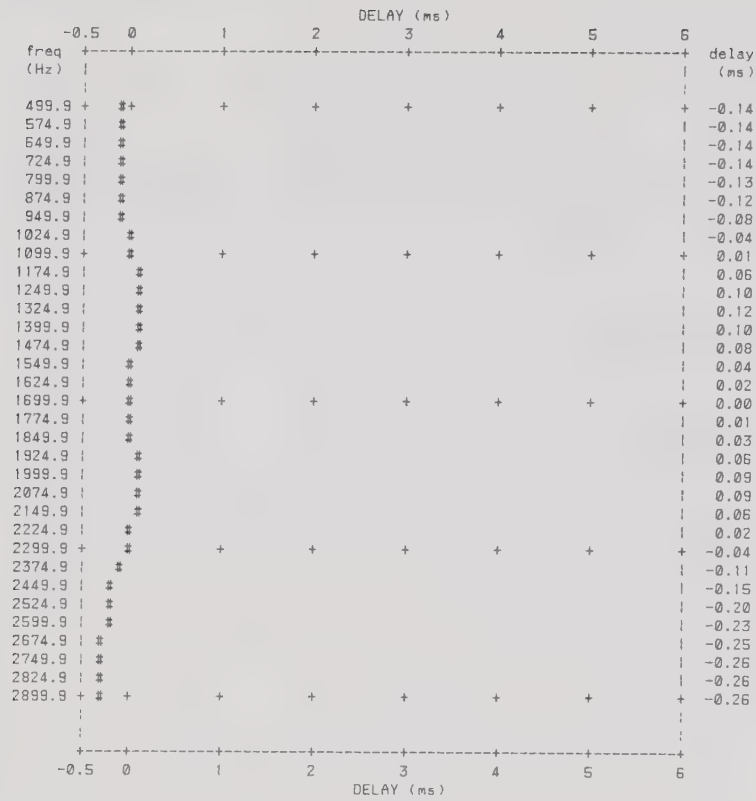
The data spectrum calculations are performed for the first time after the 4948A reaches `all measurements available` and thereafter once per minute.

`DATA SPECTRUM` is only valid when you are operating the 4948A in the `receive modem signal` mode. Data spectrum gives you two plots.

- attenuation v frequency
- group delay v frequency

```
==========================================================================
DATA SPECTRUM                                                   HP4948A
==========================================================================

--------------------------------------------------------------------------

printed:  3 Sep 1986 15:59:02

ATTENUATION referred to  1699.9 Hz

                              ATTENUATION
          -8  -6  -4  -2   0  +2  +4  +6  +8 +10 +12 +14 +16  (dB)
 freq  +------+---+---+---+---+---+---+---+---+---+---+---+---+------+   atten
 (Hz)  |                                                              |   (dB)
       :                                                              :
 499.9 +      +               +    #          +               +      +    2.7
 574.9 :                         #                                    :    1.4
 649.9 :                       #                                      :    0.5
 724.9 :                      #                                       :   -0.2
 799.9 :                     #                                        :   -0.7
 874.9 :                    #                                         :   -0.9
 949.9 :                    #                                         :   -0.9
1024.9 |                   #                                          |   -0.6
1099.9 +      +            #+              +               +      +   -0.3
1174.9 :                   #                                         :    0.0
1249.9 :                    #                                        :    0.3
1324.9 :                    #                                        :    0.5
1399.9 :                    #                                        :    0.5
1474.9 :                    #                                        :    0.3
1549.9 |                    #                                        |    0.1
1624.9 :                    #                                        :    0.0
1699.9 +      +             #              +               +      +    0.0
1774.9 :                    #                                        :    0.1
1849.9 :                     #                                       :    0.3
1924.9 :                     #                                       :    0.6
1999.9 :                      #                                      :    0.8
2074.9 :                      #                                      :    0.9
2149.9 :                      #                                      :    0.8
2224.9 :                     #                                       :    0.6
2299.9 +      +              #+             +               +      +    0.3
2374.9 :                     #                                       :    0.1
2449.9 :                     #                                       :    0.0
2524.9 :                     #                                       :    0.0
2599.9 :                      #                                      :    0.3
2674.9 :                       #                                     :    0.8
2749.9 :                        #                                    :    1.5
2824.9 :                          #                                  :    2.6
2899.9 +      +               +       #       +               +      +    4.0
       :                                                              :
       :                                                              :
       +------+---+---+---+---+---+---+---+---+---+---+---+---+------+
          -8  -6  -4  -2   0  +2  +4  +6  +8 +10 +12 +14 +16  (dB)
                              ATTENUATION
```

GROUP DELAY referred to 1699.9 Hz



Current Measurement Settings (sample print)

This print out contains all of the instrument setup information required for interpretation of printed results. It duplicates the data displayed on the **OPERATING MODE, ANALOG PORT, THRESHOLD VALUES, LOGGING▶ setup** and **LOGGING▶ summary** pages.

```
================================================================================
CURRENT MEASUREMENT SETTINGS                                          HP4948A
================================================================================

printed:  9 Sep 1986 15:37:14
--------------------------------------------------------------------------------

OPERATING MODE: receive modem signal
MODEM SELECTION: manual
MODEM: V.29 type


--------------------------------------------------------------------------------

ANALOG PORTS
             INPUT: RX1
 RECEIVE IMPEDANCE: 600 ohm: bridged
TRANSMIT IMPEDANCE: 600 ohm
--------------------------------------------------------------------------------

THRESHOLDS       limit alarms                        transients
                 ------------                        ----------
           upper signal level:    -5 dB         gain hits:   3 dB
           lower signal level:   -40 dB        phase hits:  10 deg.
           signal/noise ratio:    26 dB     impulse noise:  -6 dB w.r.to signal
      upper carrier frequency:  1705 Hz
      lower carrier frequency:  1695 Hz
    phase modulation 20-300Hz:    10 deg.
         phase jitter 4-20Hz:     10 deg.
amplitude modulation 20-300Hz:    10 %
      amplitude jitter 4-20Hz:    10 %
--------------------------------------------------------------------------------

LOGGING SUMMARY                         LOGGING SETUP

LOG START:  9 Sep 1986 15:22:08         LOG: off
 LOG STOP:  9 Sep 1986 15:34:48
 EVENTS LOGGED =   42

--------------------------------------------------------------------------------
```

As Results Are Logged (sample print)

Select `as results are logged` when you want a hard copy during testing. The first portion of the print out is the `current measurement settings.` Thereafter each time a period is completed or an event occurs you get a hard copy.

`PRINTING` remains on after the log printout has been completed. `PRINTING` may only be switched `off` manually. As long as `PRINTING` remains on, every time measurements are started with either event logging or period logging selected, a hard copy of logged results is produced complete with the appropriate header page. The log stop time is printed at the end of the printout.

Event Logging

Listed below are mnemonics and other symbols which can appear on the print out. The receiver state index numbers also appear on the print out.

Alarms		Transients	
Mnemonic	**Description**	**Mnemonic**	**Description**
LEV	Signal level	PHH	Phase hits
S/N	Signal to noise ratio	GNH	Gain hits
FRQ	Carrier frequency	IMP	Impulse noise
PHM	Phase modulation	DRO	Dropout
PHJ	Phase jitter	RTR	Instrument retraining
AMM	Amplitude modulation	DRC	Data rate change
AMJ	Amplitude jitter		

Symbol	Meaning
*	Result not applicable
-	Result not yet ready
>	Greater than
<	Less than
L	Lower threshold violated
U	Upper threshold violated

```
================================================================================
EVENTS AS THEY ARE LOGGED                                              HP4948A
================================================================================

--------------------------------------------------------------------------------
Current measurement settings

printed:  9 Sep 1986 15:22:09
................................................................................

OPERATING MODE: receive modem signal
MODEM SELECTION: manual
MODEM: V.29 type
* trying V.29 type
................................................................................

ANALOG PORTS
            INPUT: RX1
 RECEIVE IMPEDANCE: 600 ohm: bridged
TRANSMIT IMPEDANCE: 600 ohm
................................................................................

THRESHOLDS       limit alarms                        transients
                 ------------                        ----------
          upper signal level:    -5 dB         gain hits:   3 dB
          lower signal level:   -40 dB       phase hits:  10 deg.
          signal/noise ratio:    26 dB     impulse noise:  -6 dB w.r.to signal
     upper carrier frequency:  1705 Hz
     lower carrier frequency:  1695 Hz
   phase modulation 20-300Hz:    10 deg.
         phase jitter 4-20Hz:    10 deg.
amplitude modulation 20-300Hz:    10 %
      amplitude jitter 4-20Hz:    10 %
................................................................................

LOGGING SUMMARY                        LOGGING SETUP
                     * active
LOG START:  9 Sep 1986 15:22:08        LOG: events

 EVENTS LOGGED =    3

--------------------------------------------------------------------------------
--------------------------------------------------------------------------------

RECEIVER STATE CODES

 1 inactive                                12 timing offset
 2 autoranging                             13 timing and carrier offset
 3 signal too low                          14 non random data
 4 signal too high                         15 non random data and carrier offset
 5 no in-band signal                       16 non random data and timing offset
 6 training stage 1                        17 non rndm, timing and carrier offset
 7 wrong signal/ excessive impairments     18 fallback
 8 intermittent signal                     19 fallback and carrier offset
 9 training stage 2                        20 fallback and timing offset
10 all measurements available              21 fallback, timing and carrier offset
11 carrier offset

--------------------------------------------------------------------------------
```

..HP4948A Event Log.....

event time	alarms							transients						rx state
	LEV	S/N	FRQ	PHM	PHJ	AMM	AMJ	PHH	GNH	IMP	DRO	RTR	DRC	
9 Sep 15:22:08	-	-	-	-	-	-	-	0	0	0	0	0	0	2
9 Sep 15:22:09	-	-	-	-	-	-	-	0	0	0	0	0	0	6
9 Sep 15:22:14	-	-	-	-	-	-	-	0	0	0	0	0	0	9
9 Sep 15:22:57								0	0	0	0	0	0	10
9 Sep 15:23:20								1	0	4	0	0	0	10
9 Sep 15:23:21								0	0	6	0	0	0	10
9 Sep 15:23:22								0	0	6	0	0	0	10
9 Sep 15:23:23				U				0	0	4	0	0	0	10
9 Sep 15:23:24								0	0	1	0	0	0	10
9 Sep 15:23:30								1	0	0	0	0	0	10
9 Sep 15:23:31				U	U			0	0	0	0	0	0	10
9 Sep 15:23:47								0	0	4	0	0	0	10
9 Sep 15:23:48							U	0	1	5	0	0	0	10
9 Sep 15:23:49		L						0	1	6	0	0	0	10
9 Sep 15:23:50								0	1	6	0	0	0	10
9 Sep 15:24:01						U		0	0	0	0	0	0	10
9 Sep 15:24:14						U		0	0	0	0	0	0	10
9 Sep 15:24:23						U	U	0	0	0	0	0	0	10
9 Sep 15:24:35								0	1	1	1	0	0	10
9 Sep 15:24:36	L							0	0	0	0	0	0	10
9 Sep 15:24:43								0	0	1	0	0	0	10
9 Sep 15:24:44	U							0	1	0	0	0	0	10
9 Sep 15:24:45								0	1	1	0	0	0	10
9 Sep 15:24:46								1	0	0	0	0	0	10
9 Sep 15:24:58								0	1	1	1	0	0	10
9 Sep 15:25:00								0	1	0	0	0	1	18
9 Sep 15:25:46	!POWER FAILURE or DEVICE CLEAR!													1
9 Sep 15:31:24	!LOGGING RESUMED!													2
9 Sep 15:31:25	-	-	-	-	-	-	-	0	0	0	0	0	0	6
9 Sep 15:31:30	-	-	-	-	-	-	-	0	0	0	0	0	0	9
9 Sep 15:32:13								0	0	0	0	0	0	18
9 Sep 15:32:34								1	1	1	0	0	0	18
9 Sep 15:32:35								2	1	2	0	0	0	18
9 Sep 15:32:58								0	1	1	1	0	0	18
9 Sep 15:33:00			.					1	0	0	0	0	0	18
9 Sep 15:33:01	-	-	-	-	-	-	-	0	0	0	0	1	0	6
9 Sep 15:33:06	-	-	-	-	-	-	-	0	0	0	0	0	0	9
9 Sep 15:33:49								0	0	0	0	0	1	10
9 Sep 15:34:07								1	1	0	0	0	0	10
9 Sep 15:34:25								0	1	0	1	0	0	10
9 Sep 15:34:26	L							0	0	0	0	0	0	10
9 Sep 15:34:36	-	-	-	-	-	-	-	0	0	0	0	1	0	3

LOGGING STOPPED AT: 9 Sep 1986 15:34:48

Period Logging

Listed below are `warning mnemonics` and `symbols` which can appear on the print out.

Mnemonic	Description
Pf/Cl	Power failure or device clear during period.
SigLo	Receiver unable to train - signal too low.
SigHi	Receiver unable to train - signal too high.
NoSig	Receiver unable to train - no signal in receiver bandwidth.*
WSig/ExIm	Signal type does not match selected modem. OR impairments are excessive.*
IntSig	Intermittent signal.
Train	Receiver training.
FBack	Fallback constellation.
NRnd	Data is non random.*
Timeoff	Timing offset.*
CarrOff	Carrier offset.*
Stop	Logging has been stopped by the operator. This period did not run its full length.
▪	Indicates that one of above has occurred.
>	Greater than.
<	Less than.
~	Approximate period average (ie max and min range for result have been violated.)

* See Page 2-14 for explanations of these messages.

```
================================================================================
PERIODS AS THEY ARE LOGGED                                          HP4948A
================================================================================

--------------------------------------------------------------------------------
Current measurement settings

printed:  9 Sep 1986 16:00:09
................................................................................

OPERATING MODE: receive modem signal
MODEM SELECTION: manual
MODEM: V.29 type
* trying V.29 type
................................................................................

ANALOG PORTS
            INPUT: RX1
 RECEIVE IMPEDANCE: 600 ohm: bridged
TRANSMIT IMPEDANCE: 600 ohm
................................................................................

THRESHOLDS        limit alarms                      transients
                  ------------                      ----------
          upper signal level:    -5 dB        gain hits:   3 dB
          lower signal level:   -40 dB       phase hits:  10 deg.
          signal/noise ratio:    26 dB     impulse noise:  -6 dB w.r.to signal
     upper carrier frequency:  1705 Hz
     lower carrier frequency:  1695 Hz
   phase modulation 20-300Hz:    10 deg.
         phase jitter 4-20Hz:    10 deg.
amplitude modulation 20-300Hz:   10 %
      amplitude jitter 4-20Hz:   10 %
................................................................................

LOGGING SUMMARY                          LOGGING SETUP
                  * active
LOG START:  9 Sep 1986 16:00:07          LOG: periods of DURATION:  5 minutes
                                         LOG FROM: start
* no logged results

--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
RESULTS FOR PERIOD STARTED:  9 Sep 16:00:07                         HP4948A
                                        WARNINGS
                                 Pf/Cl Siglo Sighi NoSig WSig/ExIm IntSig
                                   0     0     0     0       0       0
                                 Train Fback NRnd TimeOff CarrOff  Stop
LOGGED FOR  83% OF PERIOD          #     0     0     0       0       0

          STEADY STATE MEASUREMENTS                          TRANSIENTS
-------  ------------ ---------- ---------- ---  -------------------------
             average     maximum    minimum

sig level      -9.9        -9.8      -10.0 dBm          phase hits       0
s/n ratio      34.7        34.9       34.4 dB           gain hits        0
carr freq    1699.9      1699.9     1699.9 Hz           impulses         0
phase mod      0.0         0.2        0.0 deg          dropouts         0
ph jitter      0.7         1.2        0.4 deg          ----------------------
ampl mod       0.0         0.0        0.0 %              retrains       0
ampl jitt      0.6         1.0        0.4 %        data rate changes    0
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
RESULTS FOR PERIOD STARTED:  9 Sep 16:05:07                         HP4948A
                                        WARNINGS
                                 Pf/Cl Siglo Sighi NoSig WSig/ExIm IntSig
                                   0     0     0     0       0       0
                                 Train Fback NRnd TimeOff CarrOff  Stop
LOGGED FOR 100% OF PERIOD          0     #     0     0       0       0

          STEADY STATE MEASUREMENTS                          TRANSIENTS
---  ------------------------------------------  -------------------------
             average     maximum    minimum

sig level     -10.2        -9.8      -11.5 dBm          phase hits       0
s/n ratio      35.1        35.4       33.3 dB           gain hits        2
carr freq    1699.9      1699.9     1699.9 Hz           impulses         1
phase mod      0.0         0.2        0.0 deg          dropouts         1
ph jitter      0.6         0.9        0.4 deg          ----------------------
ampl mod       0.0         0.0        0.0 %              retrains       0
ampl jitt      0.5         2.4        0.3 %        data rate changes    1
--------------------------------------------------------------------------------
```

```
!!!
```

Logged Results (sample print)

You can select past **logged results** only when the 4948A is stopped. With the log inactive, display the **PRINT▶ logged results** page.

```
PRINT▶ logged results
FROM▶      1 periods ago
THRU▶      7 periods ago
PRINTING▶ off  [use CHANGE key to print]
```

```
PRINT▶ logged results
FROM▶      1 events ago
THRU▶      7 events ago
PRINTING▶ off  [use CHANGE key to print]
```

Select the **event/period FROM** to **THRU** you want. The **event/period** selector numbers may be specified as **earliest THRU latest** or **latest THRU earliest.** The print out will always be arranged to have the **earliest** data printed first.

Event Logging

Mnemonics and symbols are described on Page 2-32.

```
================================================================================
LOGGED EVENTS                                                          HP4948A
================================================================================

--------------------------------------------------------------------------------
Logged measurement settings

printed:  9 Sep 1986 15:35:24
................................................................................

OPERATING MODE: receive modem signal
MODEM SELECTION: manual
MODEM: V.29 type
* found V.29 type
................................................................................

ANALOG PORTS
            INPUT: RX1
 RECEIVE IMPEDANCE: 600 ohm: bridged
TRANSMIT IMPEDANCE: 600 ohm
................................................................................

THRESHOLDS       limit alarms                          transients
                 ------------                          ---- --- -
          upper signal level:    -5 dB        gain hits:   3 dB
          lower signal level:   -40 dB       phase hits:  10 deg.
          signal/noise ratio:    26 dB     impulse noise:  -6 dB w.r.to signal
     upper carrier frequency:  1705 Hz
     lower carrier frequency:  1695 Hz
   phase modulation 20-300Hz:    10 deg.
        phase jitter 4-20Hz:     10 deg.
amplitude modulation 20-300Hz:    10 %
      amplitude jitter 4-20Hz:    10 %
................................................................................

LOGGING SUMMARY                        LOGGING SETUP

LOG START:  9 Sep 1986 15:22:08        LOG: events
 LOG STOP:  9 Sep 1986 15:34:48
 EVENTS LOGGED =   42

-------- -- ------------------------------------------------------------ --- ---
```

RECEIVER STATE CODES

1 inactive	12 timing offset
2 autoranging	13 timing and carrier offset
3 signal too low	14 non random data
4 signal too high	15 non random data and carrier offset
5 no in-band signal	16 non random data and timing offset
6 training stage 1	17 non rndm, timing and carrier offset
7 wrong signal/ excessive impairments	18 fallback
8 intermittent signal	19 fallback and carrier offset
9 training stage 2	20 fallback and timing offset
10 all measurements available	21 fallback, timing and carrier offset
11 carrier offset	

..HP4948A Event Log.....

event time	alarms							transients						rx state
	LEV	S/N	FRQ	PHM	PHJ	AMM	AMJ	PHH	GNH	IMP	DRO	RTR	DRC	
9 Sep 15:22:08	-	-	-	-	-	-	-	0	0	0	0	0	0	2
9 Sep 15:22:09	-	-	-	-	-	-	-	0	0	0	0	0	0	6
9 Sep 15:22:14	-	-	-	-	-	-	-	0	0	0	0	0	0	9
9 Sep 15:22:57								0	0	0	0	0	0	10
9 Sep 15:23:20								1	0	4	0	0	0	10
9 Sep 15:23:21								0	0	6	0	0	0	10
9 Sep 15:23:22								0	0	6	0	0	0	10
9 Sep 15:23:23				U				0	0	4	0	0	0	10
9 Sep 15:23:24								0	0	1	0	0	0	10
9 Sep 15:23:30								1	0	0	0	0	0	10
9 Sep 15:23:31				U	U			0	0	0	0	0	0	10
9 Sep 15:23:47								0	0	4	0	0	0	10
9 Sep 15:23:48							U	0	1	5	0	0	0	10
9 Sep 15:23:49		L						0	1	6	0	0	0	10
9 Sep 15:23:50								0	1	6	0	0	0	10
9 Sep 15:24:01						U		0	0	0	0	0	0	10
9 Sep 15:24:14						U		0	0	0	0	0	0	10
9 Sep 15:24:23						U	U	0	0	0	0	0	0	10
9 Sep 15:24:35								0	1	1	1	0	0	10
9 Sep 15:24:36	L							0	0	0	0	0	0	10
9 Sep 15:24:43								0	0	1	0	0	0	10
9 Sep 15:24:44	U							0	1	0	0	0	0	10
9 Sep 15:24:45								0	1	1	0	0	0	10
9 Sep 15:24:46								1	0	0	0	0	0	10
9 Sep 15:24:58								0	1	1	1	0	0	10
9 Sep 15:25:00								0	1	0	0	0	1	18
9 Sep 15:25:46	!POWER FAILURE or DEVICE CLEAR!													1
9 Sep 15:31:24	!LOGGING RESUMED!													2
9 Sep 15:31:25	-	-	-	-	-	-	-	0	0	0	0	0	0	6
9 Sep 15:31:30	-	-	-	-	-	-	-	0	0	0	0	0	0	9
9 Sep 15:32:13								0	0	0	0	0	0	18
9 Sep 15:32:34								1	1	1	0	0	0	18
9 Sep 15:32:35								2	1	2	0	0	0	18
9 Sep 15:32:58								0	1	1	1	0	0	18
9 Sep 15:33:00								1	0	0	0	0	0	18
9 Sep 15:33:01	-	-	-	-	-	-	-	0	0	0	0	1	0	6
9 Sep 15:33:06	-	-	-	-	-	-	-	0	0	0	0	0	0	9
9 Sep 15:33:49								0	0	0	0	0	1	10
9 Sep 15:34:07								1	1	0	0	0	0	10
9 Sep 15:34:25								0	1	0	1	0	0	10
9 Sep 15:34:26	L							0	0	0	0	0	0	10
9 Sep 15:34:36	-	-	-	-	-	-	-	0	0	0	0	1	0	3

Period Logging

Mnemonics and symbols are described on Page 2-35.

```
LOGGED PERIODS                                                    HP4948A

Logged measurement settings

printed:  9 Sep 1986 16:16:17

OPERATING MODE: receive modem signal
MODEM SELECTION: manual
MODEM: V.29 type
* found V.29 type

ANALOG PORTS
            INPUT: RX1
 RECEIVE IMPEDANCE: 600 ohm: bridged
TRANSMIT IMPEDANCE: 600 ohm

THRESHOLDS       limit alarms                    transients
                 ------------                    ----------
          upper signal level:    -5 dB       gain hits:   3 dB
          lower signal level:   -40 dB      phase hits:  10 deg.
          signal/noise ratio:    26 dB   impulse noise:  -6 dB w.r.to signal
     upper carrier frequency:  1705 Hz
     lower carrier frequency:  1695 Hz
   phase modulation 20-300Hz:    10 deg.
         phase jitter 4-20Hz:    10 deg.
amplitude modulation 20-300Hz:    10 %
      amplitude jitter 4-20Hz:    10 %

LOGGING SUMMARY                        LOGGING SETUP

LOG START:  9 Sep 1986 16:00:07        LOG: periods of DURATION:  5 minutes
 LOG STOP:  9 Sep 1986 16:15:45        LOG FROM: start
 PERIODS LOGGED =    4
```

```
RESULTS FOR PERIOD STARTED:  9 Sep 16:00:07                       HP4948A

                                          WARNINGS
                                Pf/Cl Siglo Sighi NoSig WSig/ExIm IntSig
                                   0     0     0     0      0       0
                                Train Fback NRnd TimeOff CarrOff  Stop
LOGGED FOR  83% OF PERIOD         #     0     0     0      0       0

          STEADY STATE MEASUREMENTS                          TRANSIENTS
          -------------------------                          ----------
             average     maximum     minimum

sig level      -9.9        -9.8       -10.0 dBm          phase hits      0
s/n ratio      34.7        34.9         34.4 dB            gain hits     0
carr freq    1699.9      1699.9       1699.9 Hz            impulses      0
phase mod       0.0         0.2          0.0 deg           dropouts      0
ph jitter       0.7         1.2          0.4 deg          ------------------
ampl mod        0.0         0.0          0.0 %              retrains      0
ampl jitt       0.6         1.0          0.4 %        data rate changes   0
```

```
RESULTS FOR PERIOD STARTED:  9 Sep 16:05:07                    HP4948A

                                        WARNINGS
                              Pf/Cl Siglo Sighi NoSig WSig/ExIm IntSig
                                0     0     0     0      0       0
                              Train Fback NRnd TimeOff CarrOff  Stop
LOGGED FOR 100% OF PERIOD       0     #     0     0      0       0

          STEADY STATE MEASUREMENTS                          TRANSIENTS
          -------------------------                ------------------------

            average     maximum     minimum

sig level     -10.2       -9.8       -11.5 dBm          phase hits       0
s/n ratio      35.1        35.4        33.3 dB           gain hits        2
carr freq    1699.9      1699.9      1699.9 Hz           impulses         1
phase mod       0.0         0.2         0.0 deg          dropouts         1
ph jitter       0.6         0.9         0.4 deg          ------------------------
ampl mod        0.0         0.0         0.0 %            retrains         0
ampl jitt       0.5         2.4         0.3 %            data rate changes 1
```

```
RESULTS FOR PERIOD STARTED:  9 Sep 16:10:07                    HP4948A

                                        WARNINGS
                              Pf/Cl Siglo Sighi NoSig WSig/ExIm IntSig
                                #     0     0     0      0       0
                              Train Fback NRnd TimeOff CarrOff  Stop
LOGGED FOR  79% OF PERIOD       #     #     0     0      0       0

          STEADY STATE MEASUREMENTS                          TRANSIENTS
          -------------------------                ------------------------

            average     maximum     minimum

sig level      -9.9        -9.8       -12.3 dBm          phase hits       1
s/n ratio      34.7        35.4        34.5 dB           gain hits        2
carr freq    1699.9      1700.0      1699.9 Hz           impulses         1
phase mod       0.0         0.2         0.0 deg          dropouts         1
ph jitter       0.7         1.2         0.5 deg          ------------------------
ampl mod        0.0         0.0         0.0 %            retrains         1
ampl jitt       0.6         1.1         0.4 %            data rate changes 0
```

```
RESULTS FOR PERIOD STARTED:  9 Sep 16:15:07                    HP4948A

                                        WARNINGS
                              Pf/Cl Siglo Sighi NoSig WSig/ExIm IntSig
                                0     0     0     0      0       0
                              Train Fback NRnd TimeOff CarrOff  Stop
LOGGED FOR 100% OF PERIOD       0     0     0     0      0       #

          STEADY STATE MEASUREMENTS                          TRANSIENTS
          -------------------------                ------------------------

            average     maximum     minimum

sig level      -9.9        -9.8       -10.0 dBm          phase hits       0
s/n ratio      34.7        34.9        34.6 dB           gain hits        0
carr freq    1699.9      1699.9      1699.9 Hz           impulses         0
phase mod       0.1         0.2         0.0 deg          dropouts         0
ph jitter       0.7         1.1         0.6 deg          ------------------------
ampl mod        0.0         0.0         0.0 %            retrains         0
ampl jitt       0.6         0.9         0.4 %            data rate changes 0
```

Setting the Real Time Clock

The real time clock must be set if you want to log results. Once you have set the time, the clock will continue to run until the internal battery runs down. Battery life is typically 5 years.

Display the **CLOCK SETUP** page.

```
CLOCK SETUP
            9th   Oct   1986   11:03:53
      SET▸ 21st ▸ Sep ▸ 1986  ▸10:10:00
TO STORE NEW TIME▸ use a CHANGE key
```

Enter the new date, month, year and time on line 3.

The year may be between **1901** and **2099**.

The format **HH:MM:SS** means hours : minutes : seconds.

Store the new clock settings by moving the cursor to line 4 and pressing a **CHANGE** key.

Preparing the 4948A for Remote Control 3

This section provides information which enables you to prepare the 4948A for remote control via the HP-IB or RS-232-C interfaces. The section comprises three parts:

- HP-IB or RS-232-C?
- Preparing the 4948A for HP-IB Remote Control
- Preparing the 4948A for RS-232-C Remote Control

HP-IB or RS-232-C?

The 4948A can be remotely controlled via the HP-IB or RS-232-C interfaces, with minor differences in capability.

The HP-IB itself can pass some specific information, for example remote/local, clear and service request messages. Where possible these functions have been duplicated in the 4948A by commands which can be sent via the RS-232-C interface.

HP-IB (Hewlett-Packard Interface Bus)

The HP-IB allows the connection of multiple devices to a single controller port, for example a 4948A plus associated access switches like the HP 3777A.

A single bus system is distance limited to 20m, but HP-IB extenders like the HP 37204A can increase this to over 1000m, working over coax/optical fiber with error correction. HP-IB control can be extended over dialup or leased phone lines with error correction using HP 37201A extenders and modems.

When bus extenders are used the 4948A data rates over the HP-IB under typical conditions are approximately 5k bytes/s (HP 37204A extension) or 100 bytes/s (HP 37201A plus 2.4kb/s modems).

The HP-IB allows the 4948A to request service (for example, on error).

RS-232-C (Serial Interface)

The RS-232-C can connect a single device to a controller port. Although longer connections may work, the maximum recommended length for a hardwired RS-232-C connection is 15m long at 2.4kb/s. Modems can be used to extend control over dialup or leased phone lines. Error correcting modems are recommended.

Over the RS-232-C, a controller can only discover the status of the 4948A or confirm error-free command reception by explicit polling.

Preparing the 4948A for HP-IB Remote Control

What is the HP-IB ?

The Hewlett-Packard Interface Bus (HP-IB) provides compatibility between a controller and external devices, such as the 4948A, which conform to the IEEE 488-1978 standard. Electrical, mechanical and timing compatibility are all satisfied by this interface (see Page 3-5).

The HP-IB interface is easy to use and allows great flexibility in communicating data and control information between the controller and the 4948A. It is one of the easiest methods of constructing automatic test systems.

Connecting the 4948A to the HP-IB

You should consider the following when connecting the 4948A to the bus:

- Operating distances
- Communicating with other devices on the bus

Operating Distances

The total length of HP-IB cable used to interconnect devices on the HP-IB must not exceed 2 meters (6 feet) times the number of devices in the system.

The total length of HP-IB cable used to interconnect all devices must not exceed 20 meters (65 feet).

Refer to the INSTALLATION Page 6-5 section for more details on HP-IB cables.

Operating distances can be extended using extenders.
Up to 1000m : two HP 37204A or two HP 37203A or two HP 37201A
Beyond 1000m : two HP 37201A and two modems.

Communicating with the Bus Controller

Usually, each device on the bus must have a unique address, so that the controller can access each one. The 4948A's primary address is set from the front panel, see procedure on Page 3-4.

NOTE

The 4948A has no secondary addresses.

A program running in a controller usually identifies each bus device by a **device select code.**

The device select code is made up of two parts.

- The first part is the **interface select code.** This indicates which I/O port the required device is connected to.

- The second part is the **address** which identifies which device on that port is to be selected.

EXAMPLE

In the **Demonstration Programs 1 to 4** (see Pages 4-48 to 4-51), the 4948A device select code is 705.

interface select code = 7 (in the example, this selects an HP-IB port).
primary address = 05
device select code = 705

Setting the 4948A Address

NOTE

The 4948A's HP-IB port may be used in one of two ways:

- **to allow the 4948A to control a printer (the 4948A PRINTER control must be set to HP-IB and the printer set to LISTEN ALWAYS before power up), see Page 2-25.**

- **to allow a controller to communicate with the 4948A (the 4948A must be in the addressable mode).**

To set the 4948A address to allow it to be remotely controlled via HP-IB, first display the **REMOTE** control page and select **HPIB**, then select the **ADDRESS** (a value between 0 and 30).

If you cannot change the **REMOTE** control to **HPIB**, (the display reads **RS232C only**) display the **PRINT** control page and change it to **RS232C**. Re-display the **REMOTE** control page then select **HPIB**.

In the display shown above, the ADDRESS is 5 (this value is used for all programming examples in Section 4).

The current status of the HP-IB is indicated at the bottom of the display (a ■ indicates an active state).

Flag	Explanation
RMT	The 4948A is in REMOTE state
TALK	The 4948A is addressed to talk
LSTN	The 4948A is addressed to listen
SRQ	The 4948A is issuing a service request
LOCAL LOCKOUT	Local lockout is enabled

HP-IB Capability

The interface functions of the 4948A (as defined in IEEE 488-1978) are listed below.

Code	Description
SH1	Complete capability
AH1	Complete capability
T5	Basic talker, serial poll, talk only mode, unaddress if MLA
TE0	No extended talker capability
L4	Basic listener, unaddress if MTA
LE0	No extended listener capability
SR1	Complete SRQ capability
RL1	Complete remote-local capability
PP0	No parallel poll capability
DC1	Complete device clear capability
DT0	No device trigger capability
C0	No controller capability

Local & Remote States and Messages

In the "Addressable" mode the instrument can be in one of two control states, local or remote.

At switch-on the instrument assumes the local state. In this state, all HP-IB commands will be accepted, but those that attempt to change the state of the instrument will not be obeyed. All instrument settings can be changed from the front panel.

The 4948A is put into the remote state by setting the REN signal line and by addressing the 4948A to listen. The instrument then responds to all valid HP-IB commands. In this state, results and instrument settings

may be read from the front panel, but settings may not be changed manually. Front panel indicators reflect the remote programming commands received.

The instrument can be returned from remote to the local state either by pressing the LOCAL key on the front panel or by the controller sending the "go to local" (GTL) message, or by de-asserting REN.

It is highly recommended that the 4948A be in "remote with local lockout" state (RWLS) when being controlled via the HP-IB. This will disable the front panel LOCAL key and guarantee that the system controller has sole control of the instrument at all times. To do this, the controller should send the REN message followed by the LLO message.

Device Clear & Serial Poll

Device Clear (DCL) and Selective Device Clear (SDC)

A device clear caused by the DCL or SDC multiline command over HP-IB or by a BREAK over RS-232-C will cause the 4948A to;

- abort the instrument operating system
- stop the signal processor
- disable the transmitter output
- switch the receiver input to bridging impedance
- reset the primary status register
- reset the error and self-test result FIFOs
- reset the conditions and events registers
- stop asserting service request
- reset the front panel
- restart the instrument operating system

If the 4948A is not configured for logging then after the device clear it will be stopped.

If the 4948A is configured for period or event logging and is running when the device clear occurs, then once the device clear has been completed it will autostart in the same manner as after a power failure and record a power fail/device clear (Pf/Cl) in the log.

Serial Poll

The 4948A can be serial polled at any time to retrieve the value of the `primary status byte.` A serial poll will also clear the "request service" (rsv) message (SRQ line) if this is set.

The meaning of each bit in the primary status byte is given on Page 4-43. If bit 6 of the primary status byte is set, it indicates that the 4948A is requesting service.

SPOLL (device selector) is the statement used by many controllers to carry out serial poll.

Preparing the 4948A for RS-232-C Remote Control

What is RS-232-C ?

RS-232-C is an American data communication standard maintained by the Electronic Industries Association (EIA). An equivalent international standard is CCITT V.24/V.28.

The standard defines the functional, electrical and mechanical details of a serial interface for use in connecting **data terminal equipment (DTE)**, for example a computer, terminal or printer to **data circuit terminating equipment (DCE)**, usually a modem. It does not specify the format, transmission speed or protocol of the data passed across the interface.

The standard is also widely used for the local interconnection of terminal equipment (two DTEs) although this is outside the original scope of the standard and requires special care.

For more information see **General RS-232-C Information** on Page 3-32.

RS-232-C Default Setting

Listed below are the 4948A RS-232-C interface default settings. The 4948A is shipped in this configuration and will be initialized to this configuration in the event of continuous memory loss (but not by a **RST** command).

CONNECTION ▶	modem
DUPLEX ▶	full
XON/XOFF ▶	rx & tx
ENQ/ACK ▶	off
DTR ▶	off*
SPEED ▶	1200 bps
HIGH ▶	1200 bps
LOW ▶	300 bps
PARITY ▶	1's
STOP BITS ▶	1

*This only applies if manual DTR control is selected: see Page 6-10 for further information.

Internal switch settings at shipment:

DRS (Data Rate Select): from pin 12
CH output on pin 23: ON (high) to select higher speed
DTR control: automatic

Connecting the RS-232-C

The 4948A RS-232-C interface is configured as a DTE (data terminal equipment) and can be connected to a controller or terminal either:

- via a hardwired connection
- or via a modem

The 4948A implements all signals necessary to interface to an asynchronous modem (see subset interface D in the standard). In addition, the 4948A can be configured to monitor the **Data Rate Select** signal from a dual speed modem and select one of two user selectable transmission speeds. The 4948A cannot interface to synchronous modems. The table below shows all signals implemented by the 4948A as a DTE.

Pin	Cct	Description	Mnemonic	V.24
1	AA	Protective Ground	PGND	101
2	BA	Transmitted Data (by DTE)	TXD	103
3	BB	Received Data (by DTE)	RXD	104
4	CA	Request to Send	RTS	105
5	CB	Clear to Send	CTS	106
6	CC	Data Set Ready	DSR	107
7	AB	Signal Ground	SGND	102
8	CF	Data Carrier Detect	DCD*	109
20	CD	Data Terminal Ready	DTR	108.2
22	CE	Ring Indicator	RI	125
23	CH/CI	Data Rate Select	DRS	111/112

*This signal is called **Line Signal Detect** in the RS-232-C standard. However, the mnemonic LSD is also used by modem manufacturers for Long Space Disconnect so, to avoid confusion, the 4948A uses the common alternative mnemonic **Data Carrier Detect (DCD)**.

Establishing the Connection - Quick Reference

Before information can be successfully transferred between the 4948A and a controller, a communication link must be established. You must set the necessary protocol parameters to ensure compatibility between the communicating devices. To determine the proper settings for your application, answer the following questions:

NOTE

Any device connecting to the 4948A must be set for asynchronous protocol.

- Is the connection to be hardwired or via modem?
- Have you the correct cabling for the connection you want?
- What handshake provisions are required (ENQ/ACK or XON/XOFF)?
- Is half-duplex or full-duplex line protocol being used?
- What line speed (baud rate) is being used?
- Is the modem dual speed? If so, what is the other speed?
- What parity is being used: odd, even, always zero, or always one?

NOTE

The 4948A uses seven-bit data with parity, one or two stop bits, and <cr> <lf> as the line terminator.

In the Controller

In many controllers including the HP 200/300 Series Controllers, all the above parameters are configured under program control by use of CONTROL statements. Alternatively, default values for line speed, modem handshake, and parity can be set using the datacomm interface configuration switches. Other default parameters are preset by the datacomm interface to accommodate common configurations. You can use the defaults or you can override them with CONTROL statements for program clarity and immunity to card settings.

In the 4948A

All the above parameters are configured via the REMOTE CONTROL▶ RS232C page (see Pages 3-13 to 3-15).

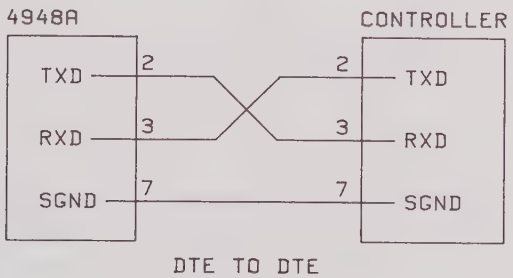
Hardwired Connection

Before connecting the 4948A to your controller, you should first establish whether the controller's RS-232-C interface is configured as DTE (data terminal equipment) or as DCE (data circuit terminating equipment) as the cabling requirements are different.

If the controller's interface is designed to connect to peripheral equipment or receives data, possibly on pin 3 (25 pin connector), it may be configured as a DCE. If it is designed to connect to a modem or transmits data, possibly on pin 2, it is likely to be a DTE.

Cabling For DTE Controller

A standard RS-232-C cable is designed to connect a DTE to a DCE. The 4948A is a DTE, so you will need a different type often called a reversing cable. The cabling requirements for connecting a DTE controller to the 4948A (DTE) are as follows:



DTE TO DTE

The main point to note in a DTE to DTE connection is the "reversal" of TXD and RXD, so that the 4948A TXD connects to the controller RXD, similarly the 4948A RXD connects to the controller TXD.

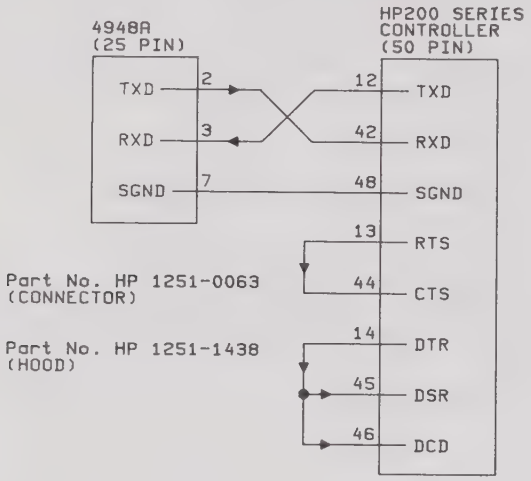
In the above diagram both devices are assumed to have the same (25 pin) connector. This is not likely to be the case in practice. Therefore, great care must be taken in making up a cable to suit your controller.

Your controller may require some or all of the modem control signals listed below to be on before data can be transmitted or received.

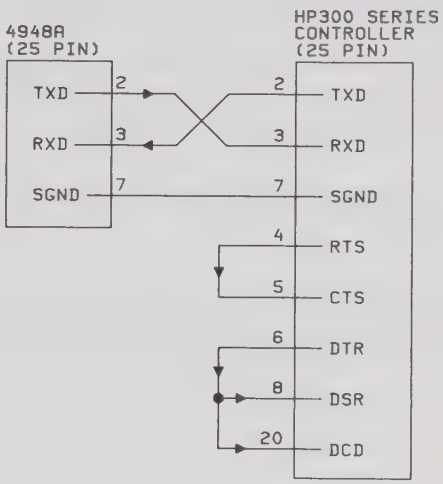
CTS: Clear to Send
DCD: Data Carrier Detect
DSR: Data Set Ready

Your interface may have a software or hardware switch to disable the modem control. If not, then you will have to provide these signals.

The easiest way of doing this, presuming that the controller correctly drives **RTS** (Request to Send) and **DTR** (Data Terminal Ready), is to connect the **RTS** output to the **CTS** input and connect the **DTR** output to the **DSR** and **DCD** inputs. This is demonstrated in the cabling diagram for the HP200 and 300 series Controllers.



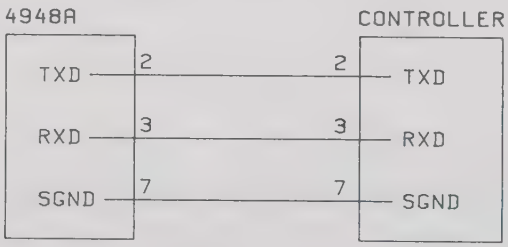
Part No. HP 1251-0086



Part No. HP 1251-0063
(CONNECTOR)
Part No. HP 1251-1438
(HOOD)

Cabling for DCE Controller

If your controller's RS-232-C interface is configured as a **DCE**, it has been designed to connect to peripheral equipment such as the 4948A (**DTE**). The cabling requirements for connecting a **DCE** controller to 4948A are as follows:



DTE TO DCE

This type of connection does not require any of the modem control signals to be **active**.

In the above diagram both devices are assumed to have the same (25pin) connector. This is not likely to be the case in practice. Therefore, great care must be taken in making up cables to suit your controller.

If your controller is configured as a **DCE**, you can use the accessory cable (HP 5060-4461) supplied with the 4948A.

Configuring the 4948A for a Hardwired Connection

NOTE

The 4948A and the controller need to have compatible speed, character format etc so that they can communicate.

1. Display the REMOTE CONTROL page and set it to RS232C▶ part 1.
2. Set CONNECTION to hardwired.
3. Select a handshake (if desired) to pace the data transmission : ENQ/ACK or XON/XOFF (see Pages 3-17 and 3-18).

```
REMOTE▶ RS232C                    ▶ part 1
CONNECTION▶ hardwired
ENQ/ACK▶ off              XON/XOFF▶ rx & tx
```

Selecting the hardwired connection may produce a WARNING message. This will appear on line 4 if the SPEED on page RS232C▶ part 2 has previously been set to selected by modem. Because this option is not available in hardwired mode the speed defaults to 1200bps.

```
REMOTE▶ RS232C                    ▶ part 1
CONNECTION▶ hardwired
ENQ/ACK▶ off              XON/XOFF▶ rx & tx
◆ WARNING: speed defaults to 1200 bps
```

4. Position the cursor next to ▶ part 1 and change it to ▶ part 2.
5. Select the transmission SPEED you want (see Page 3-19).
6. Select the character format you want, ie PARITY and STOP BITS (see Page 3-20).

When the 4948A is configured for a hardwired connection, only TXD (Transmitted Data), RXD (Received Data) and SGND (Signal Ground) are used.

The modem control inputs CTS (Clear To Send), DCD (Data Carrier Detect), DSR (Data Set Ready), RI (Ring Indicator) and DRS (Data Rate Select) are not monitored, and the modem control outputs RTS (Request To Send) and DTR (Data Terminal Ready) are not turned on.

Modem Connection

Cabling to a Modem

The simplest way to connect the 4948A to a modem is to use the accessory cable (HP5060-4461) supplied with 4948A.

If this is not available, or the connector is not compatible with your modem, then it is recommended that the cable you use should have a conductor for each of the signals implemented by the 4948A (see table on Page 3-8).

Most modems can be strapped to ignore various signals so you may be able to use a simpler cable, but do not omit the CTS (Clear to Send), DCD (Data Carrier Detect) or DSR (Data Set Ready) control signals because the 4948A requires these to enable transmission and reception.

Normally, when the 4948A is configured for modem connection, it holds DTR (Data Terminal Ready) permanently on. However, manual control of DTR can be selected by means of a switch inside the 4948A. See Manual Control of DTR on Page 6-10.

Establishing a Dialup Link

Calls are originated and answered using the modems, an autodialer (automatic calling unit) or telephone set. The 4948A is not normally involved: in its normal setting, the 4948A holds DTR (Data Terminal Ready) permanently on. However, manual control of DTR from the 4948A can be provided to allow some control of the link (see Manual Control of DTR on Page 6-10).

Configuring the 4948A for a Modem Connection

NOTE

The 4948A and the controller need to have compatible speed, character speed, character format etc so that they can communicate.

1. Display the REMOTE CONTROL page and set it to RS232C▶ part 1.
2. Set CONNECTION to modem.
3. Set DUPLEX to either half-duplex or full duplex (see Page 3-16).
4. Select a handshake (if desired) to pace the data transmission: ENQ/ACK or XON/XOFF. If the 4948A is operating half-duplex, the handshake can only be ENQ/ACK (see Page 3-17 and 3-18).

5. Position the cursor next to ▶ part 1 and change it to ▶ part 2.

6. Select the transmission SPEED you want (see Page 3-19).

7. Select the character format you want, ie PARITY and STOP BITS (see Page 3-20).

When the 4948A is configured for a modem connection, the DTR (Data Terminal Ready) output is turned on (see Manual Control of DTR on Page 6-10). Once the modem responds by turning DSR (Data Set Ready) on, communications can proceed.

Communications may be half or full duplex depending upon the type of modem used and because this affects the way in which the 4948A operates the RTS (Request To Send) CTS (Clear To Send) handshake, it is important to select the correct duplex configuration for your modem.

Duplex Operation

Half Duplex

If DTR (Data Terminal Ready) and DSR (Data Set Ready) are both on, then when the 4948A has data to transmit, it will turn on RTS (Request To Send) and will transmit the data when the modem responds by turning on CTS (Clear To Send). Once the data has been sent, the 4948A will turn off RTS (Request To Send).

The 4948A will receive data if DTR, DSR and DCD are on.

NOTE

In accordance with RS-232-C, when configured for half duplex operation the 4948A will NOT turn RTS on if CTS is already on.

Full Duplex

If DTR (Data Terminal Ready) and DSR (Data Set Ready) are both on, then the 4948A will turn on RTS (Request To Send) permanently. If the 4948A has data to transmit, then it will transmit data if CTS (Clear To Send) is on.

The 4948A will accept data if DTR (Data Terminal Ready), DSR (Data Set Ready) and DCD (Data Carrier Detect) are on.

Handshake (ENQ/ACK or XON/XOFF)

Once established, a connection allows data and commands to be transmitted continuously. However many devices, including the 4948A, cannot receive and handle commands at high data rates without some form of "pacing" mechanism. The same may be true of your controller : it may not be able to absorb command responses without pacing, especially if the response is a large volume of data such as the 4948A returns after the **LOGP** and **LOGE** commands.

In asynchronous communications, pacing is often achieved by some form of character handshake, and the 4948A provides **ENQ/ACK** and **XON/XOFF** (DC1/DC3).

ENQ/ACK (Enquiry/Acknowledge)

ENQ/ACK handshaking only paces communication from the controller to the 4948A. Data passing from the 4948A to the controller is not paced, so the controller must be able to handle the 4948A responses.

When the 4948A is paced by **ENQ/ACK** the handshake protocol is as shown below.

ENQ and **ACK** are two characters in the ASCII set, specifically codes 5 and 6.

	Tx	Rx
Controller checks to see if the 4948A can accept data	—— ENQ —→	
4948A responds that it can accept 80 characters	←— ACK ——	
Controller sends up to 80 characters.....	—— DATA —→	
.....and checks for more room	—— ENQ —→	
4948A is full and does not respond		
Controller times out after X seconds and re-enquires	—— ENQ —→	
and again after a further X seconds	—— ENQ —→	
The 4948A is ready this time, and responds	←— ACK ——	
The controller sends the next 80 characters of data	—— DATA —→	
and so on.....		

XON/XOFF (DC1/DC3)

In the options available the meaning of rx and tx is as follows:

`rx only` - The 4948A paces the rate at which the computer transmits data by sending XON and XOFF characters to the computer.

`tx only` - The computer paces the rate at which the 4948A transmits data by sending XON and XOFF characters to the 4948A.

`rx & tx` - Transmission is paced in both directions.

```
REMOTE▸ RS232C                    ▸ part 1
CONNECTION▸ hardwired
ENQ/ACK▸ off              XON/OFF▸ rx only
```

XON and XOFF are mnemonics meaning "transmitter on" and "transmitter off". The ASCII characters DC1 and DC3 are used to signal XON and XOFF.

To keep the description of this handshake general, the two parties are referred to as the transmitter and the receiver because the 4948A can operate the handshake as a receiver and/or as a transmitter.

	Tx	Rx
Transmitter sends data	—— DATA ——→	
Receiver buffer fills to upper limit and sends XOFF	←—— XOFF ——	
(transmitter stops)		
Receiver buffer empties to lower limit and sends XON	←—— XON ——	
Transmitter sends data	—— DATA ——→	
Receiver buffer fills to upper limit and sends XOFF	←—— XOFF ——	
Transmitter does not recognize XOFF and continues sending data	—— DATA ——→	
Receiver sends additional XOFFs until the transmitter stops	←—— XOFF ——	
	←—— XOFF ——	
	←—— XOFF ——	
(transmitter stops)		

No Handshake

If data is being transmitted at a high data rate, or in large quantities, then a "pacing" handshake will be necessary to avoid buffer overflow. However, the 4948A does provide the option to have no handshake for use when the controller does not implement either **ENQ/ACK** or **XON/XOFF** and would be "confused" by the extra characters. The programmer must ensure that messages to the 4948A do not exceed the buffer size of 127 bytes maximum, and that the controller can accept the 4948A's longest response (eg like the response from **LOGP** command).

Speed

When configured for hardwired connection the 4948A provides speeds of 300, 600, 1200, 1800 and 2400 bits per second (b/s). Set the speed to match the device connected to the 4948A.

When configured for modem connection, one additional "speed" option is provided, this is **selected by modem**.

```
REMOTE▸ RS232C                        ▸ part 2
SPEED▸ selected by modem   HIGH▸ 1200 bps
                                LOW▸  300 bps
7 BIT DATA,  PARITY▸ 1's     STOP BITS▸ 1
```

For (dual rate) modems which implement RS-232-C circuit **CI** - Data Rate Select (driven by the DCE), this setting allows the speed at which the 4948A transmits and receives data to be determined by the state of this circuit. It is typically used at the "answer" end of a dialup line equipped with dual rate modems. For more information, see **Dual Rate Modems** on Page 6-9.

When this option is selected, additional selector fields appear for you to select the speeds to be associated with the **HIGH** (on) and **LOW** (off) states of the Data Rate Select signal.

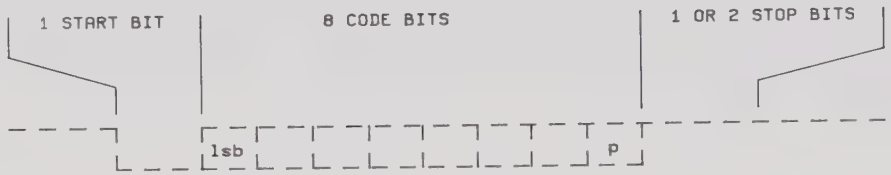
RS-232-C states that for Data Rate Select "an on condition shall select the higher data signaling rate". Therefore the range of speeds available in one field is restricted by the setting of the other, so that the low speed setting can never be higher than the high speed and vice versa. With dual rate modems, if excessive transmission errors are experienced at the high data rate, the calling modem can be commanded to try again using the low data rate. The called modem will sense the low speed, and the remote 4948A will automatically change speed to suit.

NOTE

By means of switches on the A6 assembly, either pin 23 (RS-232-C standard) or pin 12 (industry standard) can be monitored as Data Rate Select (to change the setting see Page 6-9).

Character Format

The bottom line of the display (Page 3-19) describes the asynchronous character data format. In general the format of asynchronous data is:



The 8 code bits normally consist of 7 ASCII data bits, transmitted least significant bit first, followed by 1 parity bit.

In some circumstances, for example to access a printer's alternative character set, it is useful for a full 8 bits of data to be transmitted and to achieve this, the parity bit is usually sacrificed. This is commonly referred to as "ASCII 8 bit" or "8 bit data".

The 4948A does not use 8 bit data, and the fixed string "7 BIT DATA" is simply intended as a reminder to the user.

Set the **parity** and **stop bit** options to match the device controlling the 4948A.

Parity

The parity options available are:

0's -The parity bit is always zero
1's -The parity bit is always one
ODD -The parity bit is set to 0 or 1 so that there are an odd number of 1's in the code.
EVEN -The parity bit is set to 0 or 1 so that there are an even number of 1's in the code.

To work with a controller set for 8 bit data with no parity, the 4948A must be set to 0's or 1's depending on the controller.

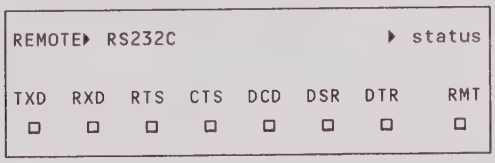
Stop Bit

It is necessary for the serial line to return to the "marking" condition between characters so that a "mark" to "space" transition, necessary for receiver synchronization, occurs at the start of each character. Normally one stop bit is sufficient to achieve this but historically 1.5 or 2 stop bits were required if the receiving hardware was electro-mechanical and could not "recover" quickly.

The 4948A offers 1 or 2 stop bits.

Reading the RS-232-C Control Status

To read the current status of the RS-232-C interface display the REMOTE▸ RS232C▸ Status page.



The mnemonics have the following meanings:

TXD : Transmitted Data
RXD : Received Data
RTS : Request To Send
CTS : Clear To Send
DCD : Data Carrier Detect
DSR : Data Set Ready
DTR : Data Terminal Ready
RMT : Remote

The RTS, CTS, DCD, DSR and DTR indicators reflect the status of the corresponding control circuits. A solid block square (■) indicates that the circuit is ON (+V at the interface), and a hollow square (□) indicates that the circuit is OFF (-V at the interface).

Because of the rate at which the Transmitted Data and Received Data signals change state they are not represented directly. Instead the TXD and RXD indicators are simply toggled on and off for the duration of data transmission and reception respectively. When data is not being passed the indicators are off.

The RMT indicator shows the REMOTE/LOCAL state of the 4948A. It is functionally the same as the RMT front panel LED.

Error Codes

The following error codes may be generated as a result of configuration and/or transmission errors when using the RS-232-C interface:

Code	Description	What to do
-160	Parity error	Check parity setting compatible
-161	Framing error	Check speed, Character format compatible
-162	Overrun error	Run self-test (see Service Manual)
-163	Input buffer overflow	Check pacing/buffer control

Demonstration Programs Using RS-232-C

The examples in this section are written in HP BASIC 4.0 running on an HP Series 200/300 Controller fitted with an HP98628A Datacomms Interface.

NOTE

The HP98626A Serial Interface built in to the HP200 Series Controller is not used because the BASIC Workstation System driver "SERIAL" does not support ENQ/ACK and XON/XOFF handshakes.

However, you can use the HP98626A if you write your program in Pascal because the HP Pascal Workstation System does support ENQ/ACK and XON/XOFF handshakes on this interface.

Hardwired Connection

To establish connection the 49487A and the controller must be compatible. The program on Page 3-23 shows how to remotely configure a controller for a typical 4948A RS-232-C setup.

NOTE

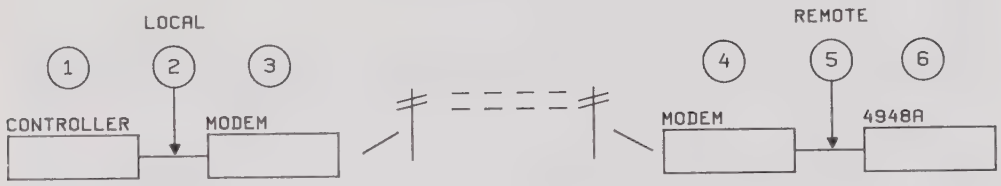
The keyboard RESET function on the HP200/300 Series Controller automatically resets the HP98628A Data Communication Interface (if fitted) to its default settings (determined by internal switch settings).

If you press the keyboard RESET, communication between the HP98628A and the 4948A will be lost. You will have to reconfigure the HP98628A to re-establish the connection.

```
10    !  ************************************************************************
20    !  *  CONFIGURING THE RS-232-C INTERFACE IN AN HP 200/300 SERIES         *
30    !  *  CONTROLLER FITTED WITH A DATA COMMUNICATION INTERFACE (HP 98628A). *
40    !  ************************************************************************
50    !
60    !  The controller is configured to communicate with a 4948A which has the
70    !  following RS-232-C settings:
80    !
90    !  REMOTE CONTROL : RS-232-C
100   !  CONNECTION     : hardwired
110   !  ENQ/ACK        : off
120   !  XON/XOFF       : rx & tx
130   !  SPEED          : 1200 b/s (bits per second)
140   !  PARITY         : odd
150   !  STOP BITS      : 1
160   !
170   !  The controller, booted in BASIC 3.0, requires the  following
180   !  binary files: ERR, DCOMM, IO and PDEV.
190   !
200   !  The following CONTROL statements configure the controller.
210   !
211   Sc=20               ! Select code of HP 98628A.
220   CONTROL Sc,0;1      ! Disconnect datacomm line (by resetting HP 98628A).
230   CONTROL Sc,3;1      ! Select ASYNC protocol.
240   CONTROL Sc,0;1      ! Start new protocol (by resetting HP 98628A).
250   CONTROL Sc,8;3      ! Set modem driver line states (RTS and DTR).
260   CONTROL Sc,20;9     ! Set transmit baud rate (1200 b/s).
270   CONTROL Sc,21;9     ! Set incoming (receiver) baud rate (1200 b/s).
280   CONTROL Sc,36;1     ! Set parity to ODD.
290   CONTROL Sc,18;255   ! Set timeout to MAXIMUM.
300   CONTROL Sc,23;0     ! Set hardware handshake to NON-MODEM.
310   CONTROL Sc,24;126   ! Set mask for control characters.
320   CONTROL Sc,22;5     ! Define protocol handshake (XON/XOFF).
330   CONTROL Sc,26;17    ! Set first handshake character to XON.
340   CONTROL Sc,27;19    ! Set second handshake character to XOFF.
350   END
```

Modem Connection

A typical long distance data communications link between an HP200/300 Series Controller and the 4948A using modems is shown below.



The following procedure will enable you to make the modem connection shown above. The procedure highlights the points you should consider when trying to make a modem connection. The equipment used to demonstrate the connection is:

Controller..... HP200/300 Series Controller
Modem HP37212A

Although the points listed below are specific to the above equipment, similar considerations should be given to alternative equipment.

1 The CONTROLLER requires the HP98628A Data Communications Interface to be fitted. The HP98628A must match the modem and 4948A operating criteria.

- The HP98628A interface can be set by means of 3 banks of dual-in-line switches; these are described in the HP98628A manual, or by software (see example).
- The HP200/300 Series Controller requires to be booted with a minimum of Basic 3.0 with binary drivers and DCOMM, IO and PDEV.
- The controller and Datacomms interface are configured as a DTE's, defaulting to:

DUPLEX .....FULL
ENQ/ACK.....OFF
XON/XOFF .....rx and tx
SPEED.....1200bps
PARITY .....1's
STOP BIT.....1

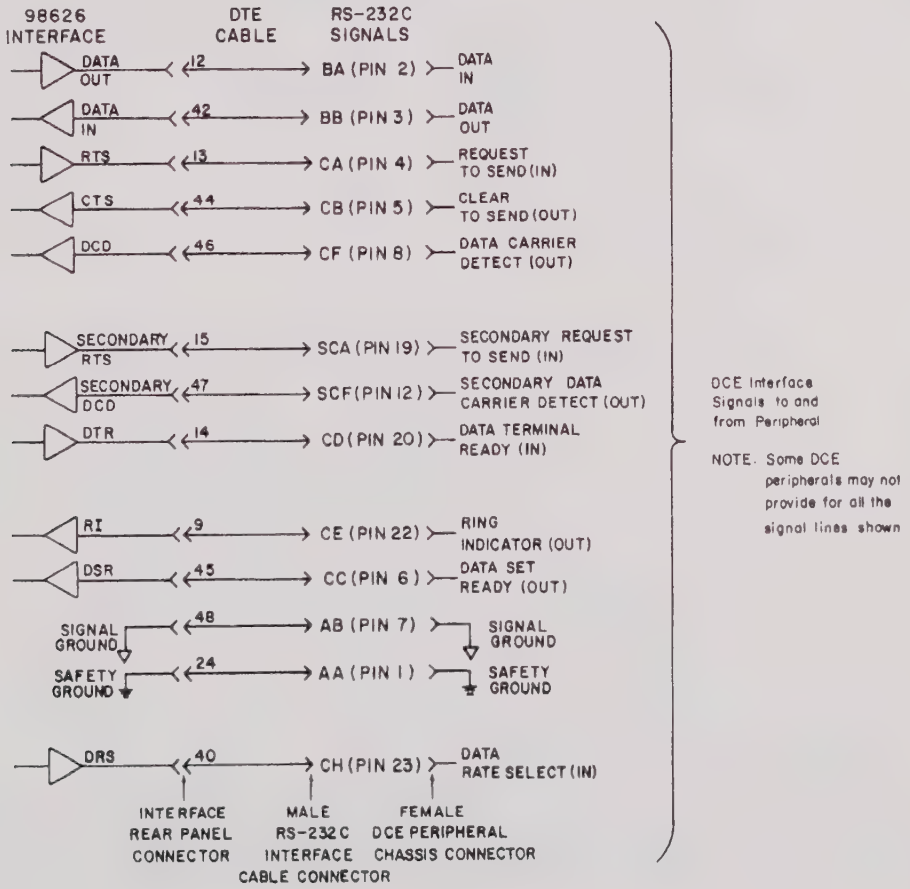
- The HP200/300 Series Controllers built-in serial interface, labeled Datacomm on some controllers and serial on others, is not used because the BASIC Workstation System Driver "SERIAL" does not support ENQ/ACK and XON/XOFF (DC1/DC3) handshakes.

2 The interconnecting cable between controller and modem should be wired as shown.

NOTE

Not all RS-232-C devices are wired the same. To ensure proper operation, you must known whether the peripheral device is wired as DTE or DCE. The interface cable option and associated adapter cable, if needed, must be configured to properly mate with the female DTE chassis connector.

The following diagram shows the input and output signals for the HP98628A and how they are connected to the modem.



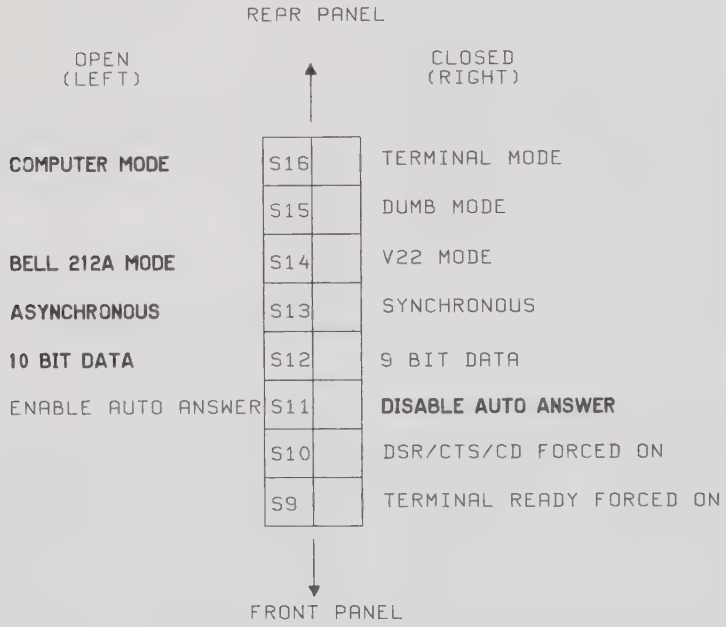
3 The LOCAL MODEM (HP37212A) is set as follows:

- All front panel switches set to the OUT position.
- The modem INTERNAL presets are set as follows:

a) Ensure the power cable is disconnected.

b) Remove the modem front and rear plastic trims. The trims are released by pushing the "ear" flaps of the trim outwards and at the same time easing the trim from the modem. See HP37212A User Manual (37212-90001) Page 2-5 for details. Remove top cover to access presets.

c) Set all the slide switches on the 8-position dual-in-line switch to the left, except for S11.



INTERNAL SWITCHES S9 - S16

The modem is configured as shown in bold in the figure above. For more details see Users Manual (37212-90001), Pages 2-8 and 2-9.

d) Connect the modem rear panel TELCO socket to the telephone line using a suitable cable. A telephone handset may be connected to the socket adjacent to the TELCO socket. A handset is essential if manual dialup is going to be used.

e) Move the LINE SELECT link to the appropriate position for LEASED or DIAL UP lines (in the example a dialup line is used). See the User Manual for more details, Page C-3.

f) The HP37212A is set to automatically sense the speed of the data (see Users Manual, Page 4-29) with the hard wired speed sensing capability disconnected. The reason for this is that the

datacomm interface configuration program resets the HP98628A interface at the beginning of each program cycle. This reset may cause the Data Rate Select line (DRS) on pin 23 to toggle which in turn may cause the modem to select a 300 baud rate. If this happens (and the controller is set to a 1200 baud rate) communication is lost. To overcome this problem remove the hardwired speed sensing CH/CI SELECT links (see Page A-9 in the 37212A Users Manual). Alternatively, remove the connections at the RS-232-C connector pins 23 and 12.

g) The modem is now ready for operation; replace covers and connect power cable.

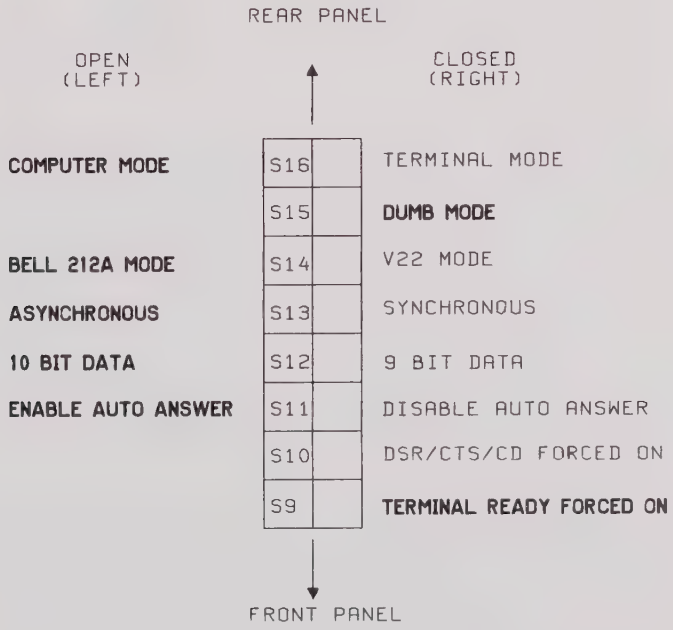
4 The REMOTE MODEM (HP37212A) is set as follows:

- All front panel switches set to the OUT position.
- To set the modem INTERNAL presets.

a) Ensure the power cable is disconnected.

b) Remove the modem top cover - see LOCAL MODEM for top cover removal, Page 3-25.

c) Set all the slide switches on the 8-position dual-in-line to the left except for S9 and S15.



INTERNAL SWITCHES S9 - S16

The modem is configured as shown in bold in the figure above. For more details see Users Manual (37212-90001), Pages 2-8 and 2-9.

d) Connect the modem rear panel TELCO socket to the telephone line via a suitable cable.

e) Reassemble modem and connect power.

5 The interconnecting cable between the modem and the 4948A is accessory cable HP 5060-4461.

6 The 4948A must exactly match the HP98628A settings. The 4948A is set up as follows:

```
REMOTE▸ RS232                    ▸ part 1
CONNECTION▸ modem          DUPLEX▸ full
ENQ/ACK▸ off             XON/XOFF▸ rx & tx
DTR▸ off*
```

*This is only displayed for manual selection of DTR and must be set to on. Normally, line 4 of the display is blank and DTR is preset to on.

```
REMOTE▸ RS232                    ▸ part 2
SPEED▸ 1200 bps

7 BIT DATA,  PARITY▸ 1's      STOP BITS 1
```

The data link is now ready to run. If the data link is not established. Listed below are some points which may help.

- If the data link fails to operate it may be useful to check the modem link without the controller. The integrity of the datacomm link can be checked by forcing DTR at the local modem, connecting a telephone handset to the modem, dialing the number and waiting to see if the carrier detect indicator (CD) on the local modem illuminates. To do this with the existing system the local modem power cable should be temporarily disconnected prior to removing the modem top cover. Setting the dual-in-line slide switch S9 to the right-hand side, forces DTR. Reconnect the telephone cable and connect a telephone handset to the modem PHONE socket (on the rear panel). Reconnect the power cable. First dial the number of the remote modem then immediately press the DATA button on the local modem. After a period between one and five minutes the CD led on the local modem should illuminate, indicating successful modem link-up is established.

- It is important to remember, that when using the HP200/300 Series Controller, pressing the Interface RESET key (to reset the BASIC operating system) automatically resets the HP98628A Datacomms Interface. This means that you are now unable to perform immediate EXECUTE instructions over the RS-232-C to the instrument, unless you either rerun a program to reconfigure the HP98628A or set the 3-dual-in-line switches on the HP98628A to the required configuration.

- If you write your own programs remember the first instruction, once Clear To Send is established, should be the RMT instruction to the 4948A. It is also worth considering ending all your programs with the LCL instructions. This is essential if anyone is likely to use the instrument manually, since the LOCAL key is inoperative when using RS-232-C communications, and the only way to return the instrument to the LOCAL modes is by switching the unit OFF then ON again.

```
10   !  ************************************************************************
20   !  *          THIS PROGRAM ESTABLISHES A MODEM CONNECTION                 *
30   !  ************************************************************************
40   !
50   !
60   !  *************************MAIN PROGRAM*********************************
70   !
80    COM Cts
90    COM Sc
100   Cts=0
110   Sc=20                              ! Assigns 20 to HP98268A Datacom Interface
120   CALL Set_dcom_reg                  ! Sets HP98268A Registers
130   ON INTR Sc CALL Check_cts          ! On INTERRUPT check CTS line.
140   CALL Auto_dial                     ! Dials up the HP98628A.
150   IF NOT Cts THEN GOTO Prog_end      ! If CTS flag false program ends.
160   CALL Check_id_ser                  ! Not used on autodial when ON INTR used.
170   CALL Disconnect                    ! Disconnects and returns instrument local
180   !
190 Prog_end: !
200           PRINT "PROGRAM END"
210   END
220   !
230   !
240   !*****************THIS SUBPROGRAM CONFIGURES THE HP98628A*****************
250   !
260   SUB Set_dcom_reg
270   !
280     COM Cts
290     COM Sc
300   !
310   ! The controller is configured to communicate with a 4948A which has the
320   ! following RS-232-C settings.
330   !
340   ! REMOTE     : RS-232-C
350   ! CONNECTION : modem
360   ! ENQ/ACK    : off
370   ! XON/XOFF   : rx & tx
380   ! SPEED      : 1200 bps (bits per second)
390   ! PARITY     : 1's
400   ! STOP BITS  : 1
410   !
420   ! The controller, booted in BASIC 3.0, requires the following
430   ! binary files: ERR, DCOMM, IO, PDEV.
440   !
450   ! The following CONTROL statements configure the HP98628A.
460   !
470     CONTROL Sc,12;1      !  Connects to  datacomm line
480     CONTROL Sc,0;1       !  Reset HP98628A.
490     CONTROL Sc,3;1       !  Configures to ASYNC after next reset.
500     CONTROL Sc,0;1       !  Start new ASYNC protocol.
510     CONTROL Sc,8;3       !  Sets DATA RATE SELECT.
520     CONTROL Sc,13;8      !  Sets INTR MASK BIT 3 modem changed line.
530     CONTROL Sc,15;4      !  Sets INTR MASK BIT 2 in reg 15 for CTS.
```

```
540     CONTROL 20,18;0     !  Set lost carrier timeout.
550     CONTROL Sc,23;0     !  Sets hardwire handshake to OFF (no modem).
560     CONTROL Sc,24;126   !  Sets data message queue.
570     CONTROL Sc,20;9     !  Set transmit baud rate to 1200 bps.
580     CONTROL Sc,21;9     !  Set incoming baud rate to 1200 bps.
590     CONTROL 20,36;4     !  Set parity to 1's.
600     CONTROL Sc,35;0     !  Set 1 STOP BIT (default value).
610     CONTROL Sc,22;5     !  Defines protocol handshake (XON/XOFF).
620     CONTROL Sc,26;17    !  Set first handshake character to XON.
630     CONTROL Sc,27;19    !  Set second handshake character to XOFF.
640     CONTROL Sc,39;10    !  Sets BREAK time in character times.
650   !
660   SUBEND
670   !
680   !
690   !*************THIS SUBPROGRAM IMPLEMENTS AUTO DIALLING******************
700   !
710   SUB Auto_dial
720     COM Cts
730     COM Sc
740   !
750     ENABLE INTR Sc;8              ! Set interrupt mask for MODEM LINE CHANGE
760     INPUT "ENTER TELEPHONE NUMBER, THEN PRESS CONTINUE ",Telephone$
770     OUTPUT Sc;"Q";CHR$(13)        ! Sets the modem to AUTO SPEED SENSE.
780     WAIT 1
790     OUTPUT Sc;"!";CHR$(13)        ! Further character for speed sensing
800     WAIT 1
810     Telephone$="S"&Telephone$     ! Prefix phone number with S for AUTO DIAL
820     OUTPUT Sc;Telephone$;CHR$(13) ! Auto dialling.
830     CONTROL Sc,23;1               ! FULL DUPLEX modem connection.
840     !
850     ! The program waits in REPEAT UNTIL loop for 30 secs for an INTERRUPT
860     ! (set when Clear to Send goes true). If no INTERUPT occurs within 30
870     ! secs program calls Disconnect.
880     !
890     REPEAT
900       PRINT "WAITING FOR CONNECTION"
910       WAIT 2
920       Secs=Secs+2
930       PRINT CHR$(12)
940       IF Secs>30 THEN
950       PRINT "UNABLE TO ESTABLISH CONNECTION "
960       CALL Disconnect
970       SUBEXIT
980       END IF
990     UNTIL Cts
1000  !
1010  SUBEND
1020  !
1030  !
1040  !************THIS SUBPROGRAM CHECKS "CLEAR TO SEND" (CTS)***************
1050  !
1060  SUB Check_cts
```

```
1070  !
1080    COM Cts
1090    COM Sc
1100    PRINTER IS 1
1110  !
1120    STATUS Sc,7;Reg_status
1130    IF BIT(Reg_status,2) THEN          ! Check status of CTS line.
1140      PRINT "CLEAR TO SEND  ";
1150      Cts=1                            ! Set CTS flag.
1160    END IF
1170  SUBEND
1180  !
1190  !
1200  !***********THIS SUBPROGRAM IDENTIFIES THE REMOTE 4948A****************
1210  !
1220  SUB Check_id_ser
1230  !
1240    DIM Id$[20]
1250    COM Cts
1260    COM Sc
1270    !
1280    CONTROL Sc,6;1                ! Sends BREAK to perform Device Clear.
1290    WAIT 2                        ! Waits to allow instrument to settle.
1300    OUTPUT Sc;"RMT"               ! Sends instrument remote.
1310    OUTPUT Sc;"ID?"               ! Requests Identification
1320    ENTER Sc;Id$                  ! Enters model number
1330    PRINT " LINK ESTABLISHED WITH ";Id$
1340  !
1350  SUBEND
1360  !
1370  !
1380  !***************THIS SUBPROGRAM DISCONNECTS THE MODEM*********************
1390  !
1400  SUB Disconnect
1410  !
1420  ! This SUB disconnects the local modem from the telephone line by
1430  ! setting DTR false which in turn causes the remote modem to disconnect.
1440  ! Line 1560 ensures the instrument is returned to local before disconnect-
1450  ! ing. If no communications link was established the "LCL" message is
1460  ! omitted. NOTE: WHEN THE REMOTE MODEM DISCONNECTS IT WILL THROW OUT
1470  ! SEVERAL SPURIOUS ASCII CHARACTERS, USUALLY ABOUT 4. THESE CHARACTERS
1480  ! ARE PICKED UP BY THE INSTRUMENT, AND THE INSTRUMENT NOT RECOGNISING
1490  ! THEM AS PART OF ITS MESSAGE REPETOIRE GENERATES AN ERROR NUMBER. THIS
1500  ! ERROR NUMBER IS RANDOM AND NO SIGNIFICANCE CAN BE ATTRIBUTED TO IT.
1510  !
1520  COM Cts
1530  COM Sc
1540  ! This SUB assumes the DTR switch(9) in the HP37212A Modem is OFF.
1550  !
1560    IF Cts THEN OUTPUT Sc;"LCL"
1570    CONTROL Sc,12;0    ! DISCONNECT FROM MODEM
1580  !
1590  SUBEND
```

General RS-232-C Information

The Electronic Industries Association (EIA) Standard RS-232-C defines "the interconnection of data terminal equipment (DTE) and data communication equipment (now known as data circuit terminating equipment) (DCE) employing serial binary data interchange". In short it defines how to connect anything to a modem.

Data Terminal Equipment is a generic term for anything you might connect to a modem, for example a terminal, computer or printer. **Data Circuit Terminating Equipment** is the name used for a modem, which is often called a "data set" in the USA.

The interface is a wire from the terminal equipment (DTE) to the modem (DCE) carrying the data to be transmitted, a wire from the modem (DCE) to the terminal equipment (DTE) carrying the received data, and a common ground wire. The signals are called Transmitted Data, Received Data and Signal Ground.

The EIA gave these signals the mnemonics **BA, BB** and **AB,** which are often ignored in favor of the more meaningful mnemonics **TXD, RXD** and **SGND.**

The RS-232-C standard suggests that the interface could be implemented using a 25 pin D-type connector, on which Transmitted Data, Received Data and Signal Ground occupy pins 2, 3 and 7 respectively. The remaining 22 pins are used for an assortment of functions, the primary one being modem (DCE) control.

RS-232-C is also widely used outside its original scope for the local, or **hardwired** interconnection of two pieces of Data Terminal Equipment, most commonly the connection of a peripheral device to a computer.

The interface was not designed to be symmetrical, so the driver/receiver configurations of Data Terminal Equipment and Data Circuit Terminating Equipment are different. This presents a problem when the RS-232-C interface is used for hardwired interconnections between two DTEs.

There is often confusion about which DTE should act as DCE, and about what should be done with the various modem control lines. These are basically redundant in the hardwired situation, but often need to be held in the correct state for communication to proceed. Break-out boxes, reversing cables, gender-benders, null-modems and so on are used to solve these problems.

Controller manufacturers commonly configure their peripheral ports to simulate Data Circuit Terminating Equipment so that peripheral devices (correctly configured as Data Terminal Equipment) can be plugged in easily.

When it is required to connect a controller to a modem then usually a more sophisticated datacomms interface card is required, or at least a special cable.

The Signals

Ground

Pin 1 is Protective Ground and should be connected to chassis. Pin 7 is Signal Ground and is the common reference for all signal lines.

Data

Pin 2 is Transmitted Data which passes from the DTE to the DCE, pin 3 is Received Data which passes from the DCE to the DTE.

Modem Control

Modems, especially when connected to the public switched telephone network (PSTN), are not always ready to transmit/receive data and therefore extra signals are required for modem control and handshaking to ensure data integrity. Pins 4, 5, 6, 8, 20, 22 and 23 are required for full modem control and these are described in the next section.

Synchronous Clocks

The RS-232-C interface can be used for either asynchronous or synchronous transmission; pins 15, 17 and 24 are allocated to "clocks" for synchronous transmission. For asynchronous applications these pins can be ignored.

Secondary Channel

Pin 12, 13, 14, 16, and 19 are allocated to the control of a secondary or backward channel. Sometimes, a low bandwidth channel is squeezed into the telephone line bandwidth below the main channel for use in status signaling or other supervisory functions. However, few modems support this facility.

Other Signals

Pins 9 and 10 are reserved for data set testing. Typically they are used by the modem to provide high and low RS-232-C signal levels.

Pin 21 is the Signal Quality Detector, which indicates whether the received line signal is good or bad, is rarely used.

Finally pins 11, 18 and 25 are unassigned.

RS-232-C Pin Assignment

The pin assignment of RS-232-C is given below, an asterisk marks those implemented by the 4948A. All signal names in the RS-232-C standard are as viewed from the DTE. The numbers in the column titled V.24 are the designations of the equivalent signals in the CCITT V.24 interface standard.

Pin	Circuit	Circuit Name	V.24
		GROUND	
1*	AA	Protective Ground	101
7*	AB	Signal Ground	102
		DATA	
2*	BA	Transmitted Data (TXD)	103
3*	BB	Received Data (RXD)	104
14	SBA	Secondary Transmitted Data	118
16	SBB	Secondary Received Data	119
		CONTROL	
4*	CA	Request To Send (RTS)	105
5*	CB	Clear To Send (CTS)	106
6*	CC	Data Set Ready (DSR)	107
8*	CF	Received Line Signal Detector - sometimes called Data Carrier Detect (DCD)	109
12	SCF	Secondary Received Line Signal Detector	122
13	SCB	Secondary Clear To Send	121
19	SCA	Secondary Request To Send	120
20*	CD	Data Terminal Ready (DTR)	108.2
21	CG	Signal Quality Detector	110
22*	CE	Ring Indicator	125
23*	CH/CI	Data Signal Rate Selector (DTE/DCE)	111/112
		TIMING	
15	DB	Transmit Signal Element Timing (DCE)	114
17	DD	Receive Signal Element Timing (DCE)	115
24	DA	Transmit Signal Element Timing (DTE)	113
9	-	Reserved for data set testing	-
10	-	Reserved for data set testing	-
11	-	unassigned	-
18	-	unassigned	-
25	-	unassigned	-

(DCE) - DCE is the source of the signal.
(DTE) - DTE is the source of the signal.
(DTE/DCE) - DTE or DCE sources signal, see pin description.

Redefinition of pins 18, 21 as per ISO 2110-1980

Pin	Cct	Description	V.24
18	-	Local Loopback	141
21	-	Remote Loopback (for point to point circuits only)	140

Standards

RS-232-C is an American interface standard which has become the de facto industry standard. The equivalent international standard is CCITT V.24/V.28 and they relate to each other as follows:

RS-232-C The electrical, mechanical and functional definition of a serial interface between DTE and DCE.

V.28 The electrical definition of a serial interface circuit. This is identical to the corresponding chapter in RS-232-C.

V.24 The functional definition of signals between a DTE and DCE. This is a super-set of the signals defined in RS-232-C because it also includes the signals required to control an Automatic Calling Unit. Where a circuit is common to RS-232-C and V.24, its definition is the same in both standards.

RS-366 The American standard for Automatic Calling Unit control.

ISO 2110 V.24 does not assign pin numbers to the signals it defines, however ISO 2110-1980 fills the gap by assigning the subset of V.24 signals which are common with RS-232-C to have the same pin assignments as RS-232-C.

EIA IEB#9 "Application Notes for EIA Standard RS-232-C" provides useful background information.

Signal Level

For all interchange signals, the function is ON when the voltage at the receiver is more positive than +3 volts with respect to signal ground, and OFF when the voltage at the receiver is more negative than -3 volts. The function is not defined in the transition region between +3 and -3 volts.

Notation	Interchange Voltage	
	Negative	Positive
Binary State	1	0
Signal Condition	Marking	Spacing
Function	OFF	ON

A loaded circuit driver should produce a signal in the range 5V to 15V, to allow a 2V noise margin. The output voltage of an open-circuit driver should not exceed 25V. The 4948A transmits voltage levels of +/-12V.

Modem Control

The following descriptions are extremely brief and are only intended as an overview. The reader is referred to the RS-232-C standard for the full definition.

The modem control signals can be separated into two groups, those responsible for answering, holding and dropping the telephone line, and those responsible for controlling data flow once the line is established.

Group 1 - Line Control

Circuit CC - Data Set Ready (CCITT 107)

In the broadest sense Data Set Ready on tells the DTE that connection has been established. More specifically, it means that the modem is connected to the line, has completed any call establishment procedure and is NOT in a test, talk or dial mode.

Circuit CD - Data Terminal Ready (CCITT 108.2)

Data Terminal Ready indicates that the terminal equipment is ready to communicate.

This signal controls the switching of the modem to the communications channel in that Data Terminal Ready must be on before the modem can connect to the communications channel and must remain on to maintain the connection. If Data Terminal Ready is turned off then the modem will disconnect.

Circuit CE - Ring Indicator (CCITT 125)

The on condition indicates that the modem has detected a ringing signal on the line. The signal is on during "rings" and off between "rings". The signal is off at all other times. This signal can be monitored by the DTE and used to turn DTR (Data Terminal Ready) on, thus allowing an auto-answer modem to answer the incoming call.

Group 2 - Data Flow Control

Circuit CA - Request to Send (CCITT 105)

This circuit is used to ready the DCE for data transmission and, on a half duplex channel, to control the direction of data transmission of the local DCE.

Turning RTS (Request To Send) on instructs the DCE to enter the transmit mode. Once the DCE is ready to transmit, it indicates this by turning CTS (Clear To Send) on. Turning RTS off instructs the DCE to complete transmission of all data passed, and then assume a non-transmit (full duplex DCE) or receive (half duplex DCE) mode as appropriate. The DCE responds to this by turning Clear To Send off.

When RTS is turned off, it should not be turned on again until CTS has been turned off by the DCE.

Circuit CB - Clear to Send (CCITT 106)

CTS (Clear To Send) indicates whether or not the DCE is ready to transmit data.

CTS on, together with RTS (Request To Send), DSR (Data Set Ready) and DTR (Data Terminal Ready) all on, indicates to the DTE that data will be transmitted to the line, whilst CTS off indicates to the DTE that it should not pass data on TXD (Transmitted Data).

The RTS/CTS handshake is primarily intended for use with DCEs that are not always capable of transmitting (half duplex or receive only modems).

Full duplex modems can (once the line is established) always transmit and therefore often do not implement the RTS/CTS handshake; instead they ignore RTS and simply turn CTS permanently on.

Half duplex modems cannot by their nature always transmit and therefore the RTS/CTS handshake must be implemented fully. A DTE must not turn RTS on if CTS is already on.

Although both modes of operation are acceptable within the framework of the RS-232-C standard, they are incompatible and it is for this reason that the 4948A provides the half/full duplex selection.

Circuit CF - Data Carrier Detect (CCITT 109)

DCD (Data Carrier Detect) indicates whether or not the DCE is receiving a line signal which is suitable for demodulation. If the line signal is lost, DCD will turn off after an appropriate guard delay.

On half duplex channels DCD is held off whenever RTS is on and for a brief interval after RTS turns off. For this reason, if no other, RTS must be monitored by a half duplex modem.

DCD on is used to qualify the reception of data from the DCE; in fact the DCE clamps RXD (Received Data) to the marking state when DCD is off.

Circuit CH/CI - Data Rate Select (CCITT 111/112)

Some modems can operate at two data rates. Normal operation is at the higher rate, say 1200bps, but if the circuit quality is poor and causing errors then the modem can be switched to a "fallback" rate, say 300bps, which, whilst slower, is less error sensitive.

RS-232-C defines two circuits, CH and CI, as data rate selectors. The circuit definitions are identical except that CH is sourced by the DTE, whilst CI is sourced by the DCE. CH is used where the DTE is controlling the transmission speed, for example at the "originate" end of a dialup line. CI is used where the modem is indicating received transmission speed so that the DTE can adapt to it - for example at the "answer" end of a dialup line. The two circuits are functionally mutually exclusive and, probably as a consequence, have both been assigned to pin 23. The decision as to which circuit to implement, i.e. whether the DTE or the DCE is to source the signal, is left to "the supplier". This is a very unsatisfactory arrangement because a dual-speed modem that can be used to originate or answer a data transmission ideally needs both circuit CH and circuit CI. The widely adopted solution is to use the normal pin, 23, for circuit CH and to redefine pin 12 (normally Secondary Received Line Signal) as circuit CI. The 4948A can be switched internally to accommodate this.

Remote Control 4

Introduction

The programming information is presented in the order you would set up and run a test remotely. The last section contains all the available commands in alphabetical order.

Use the numbered tabs to access the information you want e.g., if you want to match the 4948A receiver to the line under test, refer to tab 4.

Programming the 4948A 1

Initializing the 4948A 2

Selecting the Operating Mode 3

Matching the 4948A to the Line 4

Setting Thresholds 5

Starting and Stopping a Test 6

Receiver Status Messages 7

Reading Results 8

Period Logging 9

Event Logging 10

Setting the Real Time Clock 11

Reading the 4948A Current Settings 12

Other Commands 13

Input/Output Formats 14

Status Reporting 15

Demonstration Programs 16

Commands in Alphabetical Order 17

Programming the 4948A

Programming commands are received from a controller via the HP-IB or RS-232-C interface.

Command Format

The programming commands have three parts:

- an alpha header mnemonic
- a list of command parameters (if required)
- a command terminator

Spaces in a command string are ignored if they do not occur within a mnemonic, number or string.

Command Parameters

Parameter lists consist of decimal numbers separated by commas(,).

Combining Commands

It is possible to combine several commands into one string by using a semicolon (;) as a command separator. The whole string is executed only when the final terminator is received (see Command Terminators). In most controllers the string is written as OUTPUT Sc; "command1;command2;etc" (Sc = device select code).

Command/Response Terminators

Some of the 4948A command responses (especially those for results) contain a large number of data values. To ease the task of reading these responses they have been partitioned by a response terminator <*rt*>.

HP-IB interface. The command terminator <*ct*> can be <*nl*> ("newline") or <*cr*><*lf*> ("carriage return" "line feed") or <*EOI with last byte*> or <*cr*><*lf EOI*>. The response terminator <*rt*> will normally be <*nl*> except for the last <*rt*> of the command response which will be <*nl*> with EOI asserted. <*nl*> has the same ASCII code as <*lf*>.

RS-232-C interface. The command terminator <*ct*> can be <*nl*> or <*cr*><*lf*>. The response terminator <*rt*> will be <*cr*><*lf*>. EOI does not exist on the RS-232-C interface.

Command Validity

A command will be rejected and all subsequent commands in the same string be ignored if:

- it contains a syntax error
- it cannot be identified
- it is too long
- it has too few, too many or the wrong type of parameters
- a numeric parameter is out of range
- it is out of context

Initializing the 4948A

The following commands initialize the 4948A, regardless of the setup.

DCL : device clear (see Page 3-6)
SDC : selective device clear (see Page 3-6)
CLR : device clear (see Page 4-56)
RST : reset (see Page 4-85)

The DCL and SDC commands are only available via the HP-IB and are programmed explicitly (e.g. SDC 705). DCL, SDC and CLR all clear the remote control buffers and return the 4948A to its idle state (stopped). RST resets the 4948A measurement settings to default values. For device clear on RS-232-C interface, see Page 4-42.

Selecting the Operating Mode

NOTE

The 4948A must be STOPPED before you can change the operation of the instrument. The OPERATING MODE command and the modes you can select when testing with the 4948A are listed below.

Command Syntax : OPRM <selector><*ct*> <selector> = 1 to 3

Operating Mode	Command
receive modem signal	OPRM 1
transmit/receive tone	OPRM 2
transmit simulated modem signal	OPRM 3

For further information on the OPRM command, see Page 4-77.

Receive Modem Signal

The features you have to consider when operating in the receive modem signal mode are given here. The 4948A receiver either identifies the modem signal automatically or it is set for a specific modem type (manual selection). The MODEM SELECTION commands are given below (see also Page 4-74).

Command Syntax : MDMS <selector><*ct*> <selector> = 1 or 2

Modem Selection	Command
manual	MDMS 1
automatic	MDMS 2

If MODEM SELECTION is manual, you have to set the 4948A receiver for the modem signal type on the line. The receive modem command and choice of modem schemes are given below.

Command Syntax : RCVM <selector><*cr*> <selector> = 1 to 6

Modem	Command
201 B/C, V.26 or V.27 fallback type	RCVM 1
208, 2048 or V.27 type	RCVM 2
V.29 type	RCVM 3
2096 type	RCVM 4
209 type	RCVM 5
V.29 (1800Hz) type	RCVM 6

Example

To set up the 4948A for a V.29 type modem signal (using an HP200/300 series controller), use the following string.

```
OUTPUT Sc; "OPRM 1; MDMS 1; RCVM 3"
```

where Sc = device select code; e.g. 705 for HP-IB or 20 for RS-232-C.

Transmit/Receive Tone

In the transmit/receive tone mode the 4948A can operate as a receiver only or it can transmit and receive a tone.

The commands to select or de-select the transmitter when you run the test are given here.

Command Syntax : TRNS <control><*cr*> <control> = 0 or 1

Mode	Command
receiver only	TRNS 0
transmitter enabled	TRNS 1

For further information on the TRNS command, see Page 4-94.

If you operate the 4948A as a transmitter, you will want to set the transmitted level and frequency. The commands to do this are given here.

Command Syntax : LEVEL <level><*cr*> <level > = -40 to 0 (dBm)
FREQ <freq><*cr*> <freq > = 400 to 2810 (Hz)

For more information on LEVEL and FREQ commands, see Page 4-64 and 4-61.

Example

To transmit a tone of -13dBm at 1004Hz when you run a test (using a HP200/300 series controller) use the following command string.

```
OUTPUT Sc "OPRM 2; TRNS 1; LEVEL -13; FREQ 1004"
```

where Sc = device select code; e.g. 705 for HP-IB or 20 for RS-232-C.

Transmit Simulated Modem Signal

In the `tx simulated modem signal` mode the 4948A simulates a modem. It transmits a modem signal (the signal has no training sequence) when it is started.

Select the modem scheme you want using the TRNM command.

Command Syntax : **TRNM <selector>***<cr>* <selector> = 1 to 10

Modem	Command
201 B/C type	TRNM 1
V.26 scheme A type	TRNM 2
V.26 scheme B type	TRNM 3
208 type	TRNM 4
2048 type	TRNM 5
V.27 type	TRNM 6
V.29 type	TRNM 7
2096 type	TRNM 8
209 type	TRNM 9
V.29 (1800Hz) type	TRNM 10

To set the transmitted level, use the LEVEL command.

Command Syntax : **LEVEL <level>***<cr>* <level> = -40 to 0 (dBm)

Example

To setup the 4948A to transmit a simulated V.29 type modem signal at -13dBm, issue the following command string.

```
OUTPUT Sc; "OPRM 3; TRNM 7; LEVEL -13"
```

where Sc = device select code; e.g. 705 for HP-IB or 20 for RS-232-C.

Matching the 4948A to the Line

NOTE

The 4948A must be STOPPED to change port conditions.

When the 4948A is not running a test its receiver assumes a **bridged** termination. When testing a line which is out-of-service (end-to-end or loopback testing), the line may require to be **terminated**. There is always a source impedance at the TX port.

You can select either RX1 or RX2 port to be connected through to the 4948A's receiver. The unselected port is open circuit. The command to do this is shown below.

Command Syntax : **INPUT <selector>**<*ct*> <selector> = 1 or 2

Port	Command
RX1	INPUT 1
RX2	INPUT 2

Whether the receiver is **terminated** or **bridged**, it must be set for the correct impedance. The receiver can be set for a 600Ω or 900Ω line using the following command.

Command Syntax : **RCVI <selector>**<*ct*> <selector> = 1 or 2

Impedance	Command
600Ω	RCVI 1
900Ω	RCVI 2

If you are performing an out-of-service test, the receiver may need to be **terminated**. If you are doing in-service testing the receiver will need to be **bridged** to prevent possible loading on the line. If **terminated** is selected the 4948A will terminate the line while running.

Command Syntax : **RCVT <selector>**<*ct*> <selector> = 1 or 2

Termination	Command
bridged	RCVT 1
terminated	RCVT 2

The TX transmitter port can be set to 600Ω or 900Ω using the TRNI command.

Command Syntax : `TRNI <selector><ct>` <selector> = 1 or 2

Impedance	Command
600Ω	TRNI 1
900Ω	TRNI 2

Example

To set the 4948A receiver port to RX1, 600Ω and terminated and to set the transmitter to 600Ω, (using a HP200/300 series controller) use the following command string.

```
OUTPUT Sc; "INPUT 1; RCVI 1; RCVT 2; TRNI 1"
```

where Sc = device select code; e.g. 705 for HP-IB or 20 for RS-232-C.

Setting Thresholds

NOTE

You can set threshold limits when the 4948A is STOPPED or STARTED but not when it is logging results.

Set transient or limit alarms to suit local line conditions. Limit alarms are useful for checking deterioration in the line.

Transient Thresholds

These thresholds are used to decide whether or not a transient should be counted, while the 4948A is making measurements. If these commands are not used default values will apply (see Page 4-86).

Phase Hits

The `phase hits` threshold command and the choice of limits are given here.

Command Syntax : `PHHT <selector>`*<ct>* <selector> = 1 to 3

Threshold Limit	Command
10°	PHHT 1
15°	PHHT 2
20°	PHHT 3

Impulse Noise

The `impulse noise` threshold command and the choice of limits are given here.

Command Syntax : `IMNT <selector>`*<ct>* <selector> = 1 to 4

Threshold Limit	Command
-18dB	IMNT 1
-12dB	IMNT 2
-6dB	IMNT 3
0dB	IMNT 4

Gain Hits

The `gain hit` threshold command and the choice of thresholds are given here.

Command Syntax : `GNHT <selector><ct>` <selector> = 1 to 4

Threshold Limit	Command
1dB	GNHT 1
2dB	GNHT 2
3dB	GNHT 3
6dB	GNHT 4

Example

To set the `gain` and `phase hit` threshold, to `2dB` and `10°` respectively and to set the `impulse noise` threshold to `-6dB` (using a HP 200/300 series controller), use the following command string.

```
OUTPUT Sc; "GNHT 2; PHHT 1; IMNT 3"
```

where Sc = device select code, e.g. 705 for HP-IB or 20 for RS-232-C.

Limit Alarm Thresholds

If the 4948A is logging events, it will record when the value of a steady state measurement goes outside the limit. It will not record again unless the value has first returned inside the limit by more than the hysteresis margin. The margins are defined in the "measurement specification" (see Page 5-10). If the commands are not used, default values will apply (see Page 4-86).

Signal Level

The `signal level` alarm threshold range is -49dBm to -1dBm. The `upper` and `lower` thresholds cannot overlap.

Lower Threshold	Upper Threshold
Command Syntax : `SGLLT <threshold><ct>` <threshold> = -49 to "upper signal threshold -1" (dBm) e.g. If the upper signal level threshold is -9dBm, then the lower <threshold> range = -49 to -10 (dBm).	Command Syntax : `SGLUT <threshold><ct>` <threshold> = "lower signal threshold +1" to -1 (dBm) e.g. If the lower signal level threshold is -41dBm, then the upper <threshold> range = -40 to -1 (dBm).

Signal to Noise Ratio

The command for setting the **signal to noise ratio alarm** threshold is:

Command Syntax : **SNRT <threshold>**<*ct*> <threshold> = 18 to 38 (dB)

Carrier Frequency

The **carrier frequency** alarm threshold range is 401Hz to 2809Hz. The **upper** and **lower** thresholds cannot overlap.

Lower Threshold	Upper Threshold
Command Syntax : **CRFLT <threshold>**<*ct*> <threshold> = 401 to "upper carrier frequency threshold -1" (Hz) e.g. If the upper carrier frequency threshold is 2001Hz then, the lower (threshold> range = 401 to 2000(Hz).	Command Syntax : **CRFUT <threshold>**<*ct*> <threshold> = "lower carrier frequency threshold +1" to 2809 (Hz) e.g. If the lower carrier frequency threshold is 502Hz then, the upper <threshold> range = 502 to 2809(Hz).

Phase Modulation

The command for setting the **phase modulation** alarm threshold is:

Command Syntax : **PHMT <threshold>**<*ct*> <threshold> = 4 to 30 (degrees pk-pk)

Phase Jitter (4-20Hz)

The command for setting the **phase jitter** alarm threshold is:

Command Syntax : **PHJT <threshold>**<*ct*> <threshold> = 4 to 30 (degrees pk-pk)

Amplitude Modulation (20-300Hz)

The command for setting the **amplitude modulation** alarm threshold is:

Command Syntax : **AMMT <threshold>**<*ct*> <threshold> = 4 to 20 (% pk)

Amplitude Jitter (4-20Hz)

The command for setting the **Amplitude Jitter** alarm threshold is:

Command Syntax : **AMJT <threshold>**<*ct*> <threshold> = 4 to 20 (% pk)

Example

To set the **phase modulation** threshold to 10 degrees pk-pk and **amplitude modulation** to 8% pk (using a HP200/300 series controller), use the following command string.

```
OUTPUT Sc; "PHMT 10; AMMT 8"
```

where Sc = device select code, e.g. 705 for HP-IB or 20 for RS-232-C.

Starting and Stopping a Test

Use the START and STOP commands. There is no need for a confirmatory command (e.g. to protect data logging) as there is with front panel keystrokes (see Page 2-16). These commands work first time.

Receiver Status Messages

Once a test is started you can track its progress (until all measurements are available) using the commands RCVS (receiver state) and RMSS (receive modem search state). The receiver state is also returned as part of a response to a request for current results (see Page 4-15).

The RCVS command returns a numeric value between 1 and 21 when the 4948A is in the receive modem or transmit/receive tone modes.

Code	Status
1	receiver inactive
2	autoranging
3	autoranging, signal too low
4	autoranging, signal too high
5	autoranged, no in-band signal
6	receiver training stage 1
7	wrong signal type / excessive impairments
8	intermittent signal
9	receiver training stage 2
10	all measurements available
11	carrier offset
12	timing offset
13	timing and carrier offset
14	non random data
15	non random data, carrier offset
16	non random data, timing offset
17	non random data, timing and carrier offset
18	fallback
19	fallback, carrier offset
20	fallback, timing offset
21	fallback, timing and carrier offset

When testing using a modem signal (**receive modem signal** mode), the 4948A must identify the modem signal before valid measurements can be made. The RMSS command returns the receiver modem identification status (see table below). Found indicates it has successfully identified the modem signal.

Code	Status
1	receiver inactive
2	trying 201B/C, V.26, V.27 fallback
3	trying 208, 2048, V.27 type
4	trying V.29 type
5	trying 2096 type
6	trying 209 type
7	trying V.29 (1800 Hz) type
8	found 201B/C or V.26 scheme B
9	found V.26 scheme A or V.27 fallback
10	found 208 or 2048 type
11	found V.27 type
12	found V.29 type
13	found 2096 type
14	found 209 type
15	found V.29 (1800 Hz) type

Example

If the 4948A is trying to identify the modem signal as V.29 type, when you issue the RMSS command (using a HP200/300 series controller) it returns the following: `RMSS 4.`

Reading Results

You can access results remotely by using the commands listed below.

Results	Command
Current	CURR
Logged Event	LOGE & LOGED
Logged Period	LOGP & LOGPD

When one of the above commands is issued the 4948A returns with each measurement result, a qualification byte <qb> which qualifies the validity of the returned result. The <qb> should always be checked when reading results. The table on Page 4-14 gives an explanation for each qualification value retrieved.

Commands for reading logged results are on Pages 4-26 and 4-34.

<qb>	Qualification	Explanation
0	result valid	The result is valid and within range. A value other than 0 indicates that the result is qualified in some way.
1	result not applicable	Depending on the 4948A operating configuration, certain results will never be available - for example, "data rate changes" when addressing a modem type that has no fallback rate. The value returned with this <qb> will always be 0, even if 0 is not in the normal range for the result. The <qb> is also 1 if CURR is used when the 4948A is stopped.
2	result not yet available	While the 4948A is training certain results will not be available but will become available when training is completed. The value returned with the <qb> will always be 0, even if 0 is not in the normal range for the result.
4	result less than	The result is less than the minimum value that the 4948A can accurately measure. The value returned is the minimum level for current results or the average for logged results. This is intended to allow the user's program, having detected the <qb>, to display the minimum value preceded by the "<" sign in a similar manner to the front panel display.
8	result greater than	The result is greater than the maximum value that the 4948A can accurately measure. The value retrieved is the maximum limit for the current result or the average for logged results. This is intended to allow the users program, having detected the <qb> to display the maximum value preceded by the ">" sign in a similar manner to the front panel display.
16	result approximate	This only applies to average values, it indicates that the average includes both ">" and "<" values and must therefore be considered approximate. If an average includes some ">" values but no "<" values then it will be flagged as ">". Similarly, if there are some "<" values but no ">" values then it will be flagged "<". This is intended to allow the users program, having detected the <qb>, to display the approximate value preceded by a title or some other "approximate" sign in a similar manner to the front panel display.

Reading Current Results

A set of all current results except Data Spectrum (from the same time sample) is obtained when you issue the CURR command (see Page 4-57). The format of the returned results is shown below.

Command Syntax : CURR<*ct*>

Response :
<receiver state><*rt*>
<signal level>,<qb><*rt*>
<s/n ratio>,<qb><*rt*>
<carrier freq>,<qb><*rt*>
<phase modulation>,<qb><*rt*>
<phase jitter>,<qb><*rt*>
<amplitude modulation>,<qb><*rt*>
<amplitude jitter>,<qb><*rt*>
<hr>,<mins>,<secs><*rt*>
<phase hits>,<qb>,
<gain hits>,<qb>,
<impulse noise>,<qb>,
<dropouts>,<qb><*rt*>
<instrument retrains>,<qb><*rt*>
<data rate changes>,<qb><*rt*>

NOTE

Each measurement result is accompanied by a qualification byte <qb> (see Page 4-14). For further information on the CURR command, see Page 4-57.

8

Example : Current Results

```
10   !*************************************************************************
20   !      DISPLAYING CURRENT RESULTS USING THE "CURR" COMMAND VIA HP-IB
30   !*************************************************************************
40   !
50   ! This program demonstrates how to get current results remotely from the
60   ! 4948A. The results at the end of the program are for a transmit/receive
70   ! tone test (for this test the receive port is connected to the transmit
80   ! port). The test tone level and frequency were set to -13dBm and 1004Hz.
90   ! The test can be setup manually or remotely.
100  !
110  !
120  !
130  !*************************************************************************
140  !
150  Sc=705                          ! The 4948A HP-IB device select code.
160  REMOTE Sc                       ! Puts the 4948A into the remote state.
170  CALL Current_res(Sc)            ! Call SUBPROGRAM to retrieve results.
180  LOCAL Sc                        ! Returns the 4948A to its local state.
190  END
200  !
```

```
210   !*************************************************************************
220   !
230   SUB Current_res(Sc)
240     DIM Header$[50]
250     PRINTER IS 1                    ! Assigns the CRT as printer.
260     OUTPUT Sc;"CURR"                ! Asks the 4948A to return results.
270     ENTER Sc;Rx_status              ! 1st response returned is receiver status.
280     IF Rx_status<10 THEN PRINT "RECEIVER TRAINING "          ! Receiver
290     IF Rx_status=10 THEN PRINT "ALL MEASUREMENTS AVAILABLE" ! status checked
300     PRINT "    "
310     PRINT "-----------------------------------------------------------"
320     PRINT "MEASUREMENT                                          RESULT"
330     PRINT "-----------------------------------------------------------"
340     !
350     ! The following FOR/NEXT LOOP reads the results from the 4948A.
360     FOR N=1 TO 11
370       SELECT N
380       CASE 8      ! Enters transient timer.
390         ENTER Sc;Hours,Minutes,Seconds
400       CASE 9      ! Enters 4 transient results & qual_bytes in one go.
410         ENTER Sc;Res(1),Qual(1),Res(2),Qual(2),Res(3),Qual(3),Res(4),Qual(4)
420         PRINT "Transients timer ";TAB(50);Hours;":";Minutes;":";Seconds
430     ! This FOR/NEXT loop reads, formats & prints transient results.
440         FOR M=1 TO 4
450           READ Header$
460           PRINT Header$;
470           Qual_byte=Qual(M)! Changes variable names to suit SELECT statement
480           Results=Res(M)    ! in GOSUB Format_results.
490           GOSUB Format_results
500         NEXT M
510       CASE ELSE
520         ENTER Sc;Results,Qual_byte
530         READ Header$
540         PRINT Header$;
550         GOSUB Format_results
560       END SELECT
570     NEXT N
580     GOTO Finish         ! End of reading results GOTO SUBEND.
590   !
600   !*************************************************************************
610   !
620 Format_results: ! Checks the qual_byte for each measurement then formats.
630     SELECT Qual_byte
640     CASE 1
650       PRINT TAB(45);"NOT APPLICABLE"
660     CASE 2
670       PRINT TAB(40);"RESULT NOT YET AVAILABLE"
680     CASE 4
690       PRINT TAB(50);"<";Results
700     CASE 8
710       PRINT TAB(50);">";Results
720     CASE 16
730       PRINT TAB(50);Results;" Approximate"
740     CASE ELSE
750       PRINT TAB(50);Results
760     END SELECT
770     RETURN
780   !
790   !*************************************************************************
800   !
810     DATA Signal Level, S/N Ratio, Carrier Frequency, Phase Mod, Phase Jitter
820     DATA Amplitude Mod, Amplitude Jitter
```

```
830     DATA Phase hits, Gain Hits, Impulse Noise, Droputs
840     DATA Instrument Retrains, Data Rate Changes
850     DATA   Phase hits, Gain Hits,Impulse Noise,Droputs
860 Finish:    ! Label for SUBEND.
870   SUBEND
```

```
1     ! For RS-232-C control the main program shown above is changed in lines
2     ! 150, 160 and 180 - see below.
3     !
4     !
10    !*************************************************************************
20    !    DISPLAYING CURRENT RESULTS USING THE "CURR" COMMAND VIA RS-232-C
30    !*************************************************************************
40    !
50    ! This program demonstrates how to get current results remotely from the
60    ! 4948A. The results at the end of the program are for a transmit/receive
70    ! tone test (for this test the receive port is connected to the transmit
80    ! port). The test tone level and frequency were set to -13dBm and 1004Hz.
90    ! The tone test can be setup manually or remotely (see STATUS REPORTING,
100   ! to setting up a tone test remotely).
120   !
130   !*************************************************************************
140   !
150   Sc=20                          ! The HP98628A interface select code.
160   OUTPUT Sc;"RMT"                ! Puts the 4948A into the remote state.
170   CALL Current_res(Sc)           ! Call SUBPROGRAM to retrieve results.
180   OUTPUT Sc;"LCL"                ! Returns the 4948A to its local state.
190   END
200   !
210   ! ************************************************************************
220   ! *    Before you can run a program via the RS-232-C interface, the    *
230   ! *    controller and 4948A must be compatible - see CONFIGURING THE   *
240   ! *    4948A FOR RS-232-C REMOTE CONTROL in section 3 of the manual.   *
250   ! ************************************************************************
```

```
ALL MEASUREMENTS AVAILABLE

-----------------------------------------------------------
MEASUREMENT                                      RESULT
-----------------------------------------------------------
Signal Level                                    -6.9
S/N Ratio                                       > 45
Carrier Frequency                                1003.9
Phase Mod.                                       0
Phase Jitter                                     0
Amplitude Mod.                                   0
Amplitude Jitter                                 0
Transients timer                                 0 : 24 : 16
Phase hits                                       0
Gain Hits                                        0
Impulse Noise                                    0
Droputs                                          0
Instrument Retrains                              0
Data Rate Changes                          NOT APPLICABLE
```

Reading Data Spectrum Results

NOTE

The data spectrum calculation is performed for the first time when the 4948A reaches `all measurements available` and thereafter once per minute.

Data spectrum measurements are only valid in the `receive modem signal` operating mode. To read the most recently computed data spectrum results use the following command.

Command Syntax : `DTSP`*<ct>*

Response : `<new result>`*<rt>*
`<freq>,<atten>,<qb>,<delay>,<qb>`*<rt>* *

* If present this part of the response is repeated 33 times.

where :

<new result>	= 0 or 1
<freq>	= 395 to 2815 (Hz)
<atten>	= -18 to +18 (dB)
<delay>	= -9 to +9 (ms)

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Until results are available `<new result> = 0` and nothing further is returned.

When results are available (`<new result> = 1`) 33 sets of frequency amplitude and delay values are returned. `<new result>` is set to 1 each time a new calculation is completed and set to zero each time results are read. This means that each new set of results can only be read once. The controller may also make use of the "new data spectrum result" status bit in the miscellaneous events register (see Page 4-45) to indicate results are available.

NOTE

Data spectrum are not logged. However they may be read as usual when the 4948A is logging and if still available, may be read (once) after the 4948A has stopped. For more information on DTSP see Page 4-59.

Example: Data Spectrum

```
!*************************************************************************
!      DISPLAYING THE DATA SPECTUM USING THE "DTSP" COMMAND VIA HP-IB
!*************************************************************************
!
! This program retrieves and displays data spectrum log.
!
!-------------------------------------------------------------------------
!
Sc=705                    ! The 4948A HP-IB device select code.
REMOTE Sc                 ! Puts the 4948A in the remote state.
CALL Data_spec(Sc)        ! Call SUBPROGRAM to retrieve data spectum..
LOCAL Sc                  ! Returns the 4948A to the local state.
END
!
!-------------------------------------------------------------------------
!
SUB Data_spec(Sc)
!
  PRINTER IS 1      ! Assigns the CRT as the printer.
!
!*********************REQUEST DATA SPECTRUM*******************************
Req_data_spect:  !
  OUTPUT Sc;"DTSP "
!
!*********************DISPLAY DATA SPECTRUM*******************************
!
  ENTER Sc;Res_ready_flag
  IF Res_ready_flag THEN GOTO Read_results
  DISP " New data spectum not available yet, please wait."
  WAIT 15
  GOTO Req_data_spect
  !************************READ RESULTS**************************************
  !
Read_results:      !
  PRINT "  "
  PRINT "-----------------------------------------"
  PRINT "FREQ";TAB(20);"ATTEN";TAB(40);"DELAY"
  PRINT "-----------------------------------------"
  FOR X=1 TO 33
  ENTER Sc;Freq,Atten,Qual1,Delay,Qual2
  PRINT Freq;
  Qual_byte=Qual1
  Results=Atten
  Tab_space=20
  GOSUB Format_results
  Qual_byte=Qual2
  Results=Delay
  Tab_space=40
  GOSUB Format_results
  NEXT X
  GOTO Finish
!******************** FORMAT AND PRINT RESULTS*****************************
!
Format_results:  !
  M=Tab_space
  SELECT Qual_byte
```

```
530     CASE 1
540       PRINT TAB(M);"RESULT NOT APPLICABLE"
550     CASE 2
560       PRINT TAB(M);"RESULT NOT YET AVAILABLE"
570     CASE 4
580       IF M=20 THEN
590         PRINT TAB(M);"<";Results;
600       ELSE
610         PRINT TAB(M);"<";Results
620       END IF
630     CASE 8
640       IF M=20 THEN
650         PRINT TAB(M);">";Results;
660       ELSE
670         PRINT TAB(M);">";Results
680       END IF
690     CASE 16
700       IF M=20 THEN
710         PRINT TAB(M);Results;"Approx";
720       ELSE
730         PRINT TAB(M);Results;"Approx"
740       END IF
750     CASE ELSE
760       IF M=20 THEN
770         PRINT TAB(M);Results;
780       ELSE
790         PRINT TAB(M);Results
800       END IF
810     END SELECT
820     RETURN
830     !
840 Finish:   !
850   DISP "  "
860   SUBEND
```

```
1     ! For RS-232-C control the main program shown above is changed in lines
2     ! 90, 100 and 120 - see below.
3     !
4     !
10    !*************************************************************************
20    !    DISPLAYING THE DATA SPECTRUM USING THE "DTSP" COMMAND VIA RS-232-C
30    !*************************************************************************
40    !
50    ! This program retrieves and displays the data spectrum log.
60    !
70    !-------------------------------------------------------------------------
80    !
90    Sc=20               ! The 4948A device select code.
100   OUTPUT Sc;"RMT"     ! Puts the 4948A into the remote state.
110   CALL Data_spec(Sc) ! Call SUBPROGRAM to retrieve data spectrum.
120   OUTPUT Sc;"LCL"     ! Returns the 4948A to the local state.
130   END
131   !
140   ! ***********************************************************************
150   ! *     Before you can run a program via the RS-232-C interface, the    *
160   ! *     controller and 4948A must be compatible - see CONFIGURING THE   *
170   ! *     4948A FOR RS-232-C REMOTE CONTROL in section 3 of the manual.   *
180   ! ***********************************************************************
```

FREQ	ATTEN	DELAY
1200	4.9	-.17
1237.5	3.8	-.18
1275	3.1	-.17
1312.5	2.6	-.17
1350	2.4	-.16
1387.5	2	-.15
1425	1.8	-.14
1462.5	1.5	-.12
1500	1.3	-.1
1537.5	1	-.08
1575	.7	-.07
1612.5	.5	-.05
1650	.3	-.03
1687.5	.2	-.01
1725	.1	0
1762.5	0	.01
1800	0	0
1837.5	0	0
1875	.1	0
1912.5	.3	-.02
1950	.4	-.03
1987.5	.6	-.05
2025	.9	-.07
2062.5	1.1	-.08
2100	1.3	-.1
2137.5	1.6	-.12
2175	1.8	-.13
2212.5	2	-.15
2250	2.3	-.15
2287.5	2.5	-.16
2325	2.9	-.16
2362.5	3.5	-.16
2400	4.5	-.16

Period Logging

Seven commands provide remote control of logging. They are listed here in the order you should use them.

Description	Commands
Select the type of logging you want	LOG
Logging period duration	DRTN
When do you want to start logging	LGFR
Read the current state of the logging process	LOGS
When did logging start	LSTRT
When did logging stop	LSTPT
How many periods have been logged	PRDL

Set the 4948A for period logging with the command **LOG 2** (see Page 4-65).

Set the period duration with the **DRTN** command.

Command Syntax : **DRTN <selector>**<*ct*> <selector> = 1 to 4

Duration	Command
5 minutes	DRTN 1
15 minutes	DRTN 2
30 minutes	DRTN 3
60 minutes	DRTN 4

Decide when to start logging with the **LGFR** command.

Command Syntax : **LGFR <selector>,<hours>,<minutes>**<*ct*>

where : <selector> = 1 or 2 (1 = start, 2 = time, see following table)
<hours> = 0 to 23
<minutes> = 0 to 59

Log From		Command
start:	To log from when the START key is pressed or when the START command is issued, set <selector> to 1. The <hours> and <minutes> parameters are ignored but dummy values must be supplied.	LGFR 1,0,0
time:	To log from a predetermined time in the future set <selector> to 2. The <hours> and <minutes> define the start time. Logging will commence when this time first occurs, up to 24 hours later. The example shows that logging is to start at 3.30p.m. (15:30).	LGFR 2,15,30

Read the current state for the logging process with the LOGS command.

Command Syntax : LOGS<*cf*>

Response : <state><*rf*> <state> = 1 to 5

<state>	Logging State
1	off
2	imminent
3	autosearch start
4	waiting for time
5	active

To enquire about the log start and stop times, use the LSTRT and LSTPT commands respectively (see Page 4-74 and 4-73 respectively).

Command Syntax : LSTRT<*cf*> for log start time

LSTPT<*cf*> for log stop time

The response to the above commands is similar. The first value returned is an availability flag. In either case, if no time has been recorded, then <validity> = 0 and no time is returned.

Response : <validity><*rf*>
<month>,<day of month>,<hours>,
<minutes>, <seconds><*rf*>

where : <validity> = 0 or 1
<month> = 1 to 12
<day of month> = 1 to 28,29,30 or 31 (range depends on month and year)
<hours> = 0 to 23
<minutes> = 0 to 59
<seconds> = 0 to 59

If <validity> = 0 then there is no recorded time.
If <validity> = 1 then there is a recorded time.

To find out how many periods have been logged use the following command:

Command Syntax : PRDL<*ct*>

Response : <period count><*rt*> <period count> = 0 to 200

Reading the Period Log

There are two commands you can use to read the period log:

- Use the LOGP command to read the most recently logged periods up to a selectable maximum of 200 (see Page 4-68).
- Use the LOGPD command to read logged data on a regular basis, ensuring that no data is missed or duplicated. When LOGPD is issued, the 4948A returns all data logged since the last LOGPD command or since the start of period logging, (see page 4-71).

The response to the LOGP command is:

<request status><*rt*>
<number of periods><*rt*><data block>*

The response to the LOGPD command is:

<number of periods><*rt*><data block>*

* A <data block> is returned for each period, ie if the <number of periods> = 3 then 3 <data block>s are returned.

Each <data block> is time stamped and each result is accompanied by a qualification byte <qb>. If power is off for one or more complete periods, no data is logged for these periods and no logging memory is used up. The presence of a time discontinuity in the log is noted in the logged status for the period following the power failure. For further information on LOGP and LOGPD, see Pages 4-68 and 4-71.

Example : Reading the Period Log

```
10    !*************************************************************************
20    !      DISPLAYING THE PERIOD LOG USING THE "LOGP" COMMAND VIA HP-IB
30    !*************************************************************************
40    !
50    ! This program retrieves and displays periods from the period log. The
60    ! user need only enter the date, time and number of periods.
70    !
80    !*************************************************************************
90    !
100   Sc=705              ! The 4948A HP-IB device select code.
110   REMOTE Sc           ! Puts the 4948A in the remote state.
120   CALL Loge(Sc)       ! Call SUBPROGRAM to retrieve periods.
130   LOCAL Sc            ! Returns the 4948A to the local state.
140   END
150   !
160   !*************************************************************************
170   !
180   SUB Loge(Sc)
190   !
200   !*************************************************************************
210   !                                  PART 1
220   !    ENTER THE DATE, TIME AND THE NUMBER OF PERIODS YOU WANT DISPLAYED
230   !*************************************************************************
240   !
250     PRINTER IS 1      ! Assigns the CRT as the printer.
260     PRINT "To dump the period log :"
270     PRINT "Enter date ( day, month, year) then press RETURN."
280     INPUT C,B,A       ! Key in date.
290     A=A+1900          ! Converts year (XX) to 19XX.
300     PRINT "Enter time ( hours, minutes, seconds) then press RETURN."
310     INPUT D,E,F       ! Key in time.
320     PRINT "Enter the number of periods you want, then press RETURN."
330     INPUT G           ! Key in number of periods.
340   !
350   !*************************************************************************
360   !                                  PART 2
370   !                          DISPLAY THE PERIOD LOG
380   !*************************************************************************
390   !
400   !
410   !*************************DIMENSION VARIABLES*****************************
420   !
430     DIM Month$(12)[10]
440     DIM Header$[50]
450     DIM Res(4)
460     DIM Qual(4)
470   !
480   ! This FOR/NEXT loop reads the months of the year.
490   !
```

```
500     FOR Month=1 TO 12
510       READ Month$(Month)          ! Fills 12 arrays with months of year
520                                   ! Month$(1) contains  JAN
530     NEXT Month
540   !
550   !*************************REQUEST THE LOG ****************************
560   !
570     OUTPUT Sc;"LOGP "&A&","&B&","&C&","&D&","&E&","&F&","&G
580   !
590   !*************************DISPLAY LOG STATUS***************************
600     ENTER Sc;H,No_of_periods
610     IF H=1 THEN PRINT "No logged results at"&D&","&E&","&F&"."
620     IF H=2 THEN PRINT "Time"&D&","&E&","&F&"is earlier than the earliest
period in the log."
630     IF H=3 THEN PRINT "Time"&D&","&E&","&F&"is in the log."
640     IF H=4 THEN PRINT "Time"&D&","&E&","&F&"is later than the latest period
in the log."
650     PRINT " "
660     PRINT "Number of periods to be printed ="&No_of_periods
670     PRINT " "
680   !
690   !****************
700   !
710   ! This FOR/NEXT loop returns all results for each period.
720   !
730     FOR X=1 TO No_of_periods
740       ENTER Sc;Y,M,D,Times$
750       ENTER Sc;Logging_percent
760       ENTER Sc;Log_status
770       PRINT "  "
780       PRINT "  "
790       PRINT "***************** Period ending "&D&Month$(M)&" at "&Times$&" *
******************"
800       PRINT "  "
810       IF Log_status=0 THEN
820         PRINT "The 4948A logged"&Logging_percent&"% of period."
830       ELSE
840         PRINT "The 4948A logged"&Logging_percent&"% of period , due to the f
ollowing:"
850         PRINT "  "
860       END IF
870       GOSUB Log_status      ! Formats and prints log status.
880       GOSUB Log_results     ! Formats and prints results.
890       RESTORE 2400
900     NEXT X
910 !
920 !*****************************************************************************
930 !
940   GOTO Finish
950 !
960 !*****************************************************************************
970 !
980 Log_status:   !
990     IF Log_status>0 THEN
1000      IF BIT(Log_status,0) THEN PRINT "    Power Failure"
1010      IF BIT(Log_status,1) THEN PRINT "    Stop"
1020      IF BIT(Log_status,2) THEN PRINT "    Time discontinuity in the log"
```

```
1030      IF BIT(Log_status,4) THEN PRINT "    Training"
1040      IF BIT(Log_status,5) THEN PRINT "    Signal too low"
1050      IF BIT(Log_status,6) THEN PRINT "    Signal too high"
1060      IF BIT(Log_status,7) THEN PRINT "    No in-band signal"
1070      IF BIT(Log_status,8) THEN PRINT "    Wrong signal/excessive impairment
s"
1080      IF BIT(Log_status,9) THEN PRINT "    Intermittent signal"
1090      IF BIT(Log_status,11) THEN PRINT "    Carrier offset"
1100      IF BIT(Log_status,12) THEN PRINT "    Timing offset"
1110      IF BIT(Log_status,13) THEN PRINT "    Non random data"
1120      IF BIT(Log_status,14) THEN PRINT "    Fallback"
1130    ELSE
1140      PRINT "  "
1150      PRINT "   All measurements available"
1160      PRINT "  "
1170    END IF
1180    RETURN
1190 !
1200 !*************************************************************************
1210 !
1220 Log_results:  !
1230 !
1240    PRINT "------------------"
1250    PRINT "  "
1260    PRINT "  "
1270 !
1280 ! Steady state header follows.
1290 !
1300    PRINT TAB(25);"STEADY STATE IMPAIRMENTS"
1310    PRINT "-------------------------------------------------------------------
1320    PRINT "MEASUREMENT";TAB(28);"AVERAGE";TAB(42);"MINIMUM";TAB(56);"MAXIMUM
1330    PRINT "-------------------------------------------------------------------
1340 !
1350 ! This FOR/NEXT loop formats & reads each STEADY STATE MEASUREMENT.
1360 !
1370    FOR Alarms=1 TO 7
1380      ENTER Sc;Res(1),Qual(1),Res(2),Qual(2),Res(3),Qual(3)
1390      READ Header$
1400      PRINT Header$;
1410 !
1420 ! This FOR/NEXT loop formats the AVERAGE MINIMUM and MAXIMUM results.
1430 !
1440      FOR Values=1 TO 3
1450        Results=Res(Values)       ! Changes variablenames to suit
1460        Qual_byte=Qual(Values)    ! SELECT statement in GOSUB Format
1470                                  ! results1.
1480        LET M=(Values+1)*14       ! Sets tab in GOSUB Format_results1.
1490        GOSUB Format_results1     ! Formats and prints steady state
1500      NEXT Values                 ! alarms.
1510    NEXT Alarms
1520    PRINT "  "
1530    PRINT "  "
1540 !
1550 ! Transient header follows.
```

```
1560 !
1570    PRINT TAB(14);"TRANSIENTS"
1580    PRINT "---------------------------------"
1590    PRINT "MEASUREMENT";TAB(28);"COUNT"
1600    PRINT "---------------------------------"
1610 !
1620    ENTER Sc;Res(1),Qual(1),Res(2),Qual(2),Res(3),Qual(3),Res(4),Qual(4)
1630 !
1640 ! This FOR/NEXT loop allows the transient results to be formatted.
1650 !
1660    FOR Values=1 TO 4
1670      READ Header$
1680      PRINT Header$;
1690      Results=Res(Values)      ! Changes variable names to suit SELECT
1700      Qual_byte=Qual(Values)   ! statement in GOSUB Format_results2.
1710      GOSUB Format_results2    ! Formats and prints transient results.
1720    NEXT Values
1730    PRINT "  "
1740    PRINT "---------------------------------"
1750 !
1760    ENTER Sc;Res(1),Qual(1),Res(2),Qual(2)
1770    FOR Values=1 TO 2
1780      READ Header$
1790      PRINT Header$;
1800      Results=Res(Values)
1810      Qual_byte=Qual(Values)
1820      GOSUB Format_results2
1830    NEXT Values
1840    RETURN
1850 !
1860 !*****************************************************************************
1870 !
1880 Format_results1: !    (STEADY STATE IMPAIRMENTS)
1890    SELECT Qual_byte
1900    CASE 1
1910      PRINT TAB(25);"RESULT NOT APPLICABLE"
1920    CASE 2
1930      PRINT TAB(25);"RESULT NOT YET AVAILABLE"
1940    CASE 4
1950      IF Values<3 THEN
1960        PRINT TAB(M);"<";Results;
1970      ELSE
1980        PRINT TAB(M);"<";Results
1990      END IF
```

```
2000    CASE 8
2010      IF Values<3 THEN
2020        PRINT TAB(M);">";Results;
2030      ELSE
2040        PRINT TAB(M);">";Results
2050      END IF
2060    CASE 16
2070      IF Value<3 THEN
2080        PRINT TAB(M);Results;"Approx";
2090      ELSE
2100        PRINT TAB(M);Results;"Approx"
2110      END IF
2120    CASE ELSE
2130      IF Values<3 THEN
2140        PRINT TAB(M);Results;
2150      ELSE
2160        PRINT TAB(M);Results
2170      END IF
2180    END SELECT
2190    RETURN
2200    !
2210 Format_results2: !   (TRANSIENTS)
2220    SELECT Qual_byte
2230    CASE 1
2240      PRINT TAB(25);"RESULTS NOT APPLICABLE"
2250    CASE 2
2260      PRINT TAB(25);"RESULT NOT YET AVAILABLE"
2270    CASE 4
2280      PRINT TAB(28);"<";Results
2290    CASE 8
2300      PRINT TAB(28);">";Results
2310    CASE 16
2320      PRINT TAB(28);Results;"Approx"
2330    CASE ELSE
2340      PRINT TAB(28);Results
2350    END SELECT
2360    RETURN
2370    !*************************************************************************
2380    !
2390    DATA JAN,FEB,MAR,APR,MAY,JUN,JUL,AUG,SEP,OCT,NOV,DEC
2400    DATA Signal Level,S/N Ratio,Carrier Frequency,Phase Modulation
2410    DATA Phase Jitter,Amplitude Modulation,Amplitude Jitter
2420    DATA Phase Hits,Gain Hits,Impulse Noise,Dropouts
2430    DATA Insrument Retrains,Data Rate Changes
2440 Finish:  !
2450  SUBEND
```

```
1     ! For RS-232-C control the main program shown above is changed in lines
2     ! 100, 110 and 130 - see below.
3     !
4     !
10    !*************************************************************************
20    !    DISPLAYING THE PERIOD LOG USING THE "LOGP" COMMAND VIA RS-232-C
30    !*************************************************************************
40    !
50    ! This program retrieves and displays periods from the period log. The
60    ! user need only enter the date, time and number of periods.
70    !
80    !*************************************************************************
90    !
100   Sc=20              ! The HP98628A interface select code.
110   OUTPUT Sc;"RMT"    ! Puts the 4948A in the remote state.
120   CALL Loge(Sc)      ! Call SUBPROGRAM to retrieve periods.
130   OUTPUT Sc;"LCL"    ! Returns the 4948A to the local state.
140   END
150   !
160   ! ************************************************************************
170   ! *     Before you can run a program via the RS-232-C interface, the     *
180   ! *     controller and 4948A must be compatible - see CONFIGURING THE    *
190   ! *     4948A FOR RS-232-C REMOTE CONTROL in section 3 of the manual.    *
200   ! ************************************************************************
```

********** Period ending 19 NOV at 07,13,59 **********

The 4948A logged 84 % of period , due to the following:

Training

STEADY STATE IMPAIRMENTS

MEASUREMENT	AVERAGE	MINIMUM	MAXIMUM
Signal Level	-20	-20	-20
S/N Ratio	> 45	> 45	> 45
Carrier Frequency	2001	2001	2001
Phase Modulation	0	0	0
Phase Jitter	0	0	0
Amplitude Modulation	0	0	0
Amplitude Jitter	0	0	0

TRANSIENTS

MEASUREMENT	COUNT
Phase Hits	0
Gain Hits	0
Impulse Noise	0
Dropouts	0

Insrument Retrains	0
Data Rate Changes	RESULTS NOT APPLICABLE

********** Period ending 19 NOV at 07,18,59 **********

The 4948A logged 100 % of period.

All measurements available

STEADY STATE IMPAIRMENTS

MEASUREMENT	AVERAGE	MINIMUM	MAXIMUM
Signal Level	-20	-20	-20
S/N Ratio	> 45	> 45	> 45
Carrier Frequency	2001	2001	2001
Phase Modulation	0	0	0
Phase Jitter	0	0	0
Amplitude Modulation	0	0	0
Amplitude Jitter	0	0	0

```
                TRANSIENTS
-----------------------------------
MEASUREMENT                  COUNT
-----------------------------------
Phase Hits                     0
Gain Hits                      0
Impulse Noise                  0
Dropouts                       0

-----------------------------------
Insrument Retrains             0
Data Rate Changes       RESULTS NOT APPLICABLE


***************** Period ending  19 NOV at 07,23,59 ******************

The 4948A logged 100 % of period.

   All measurements available

------------------
```

```
                          STEADY STATE IMPAIRMENTS
-------------------------------------------------------------------------
MEASUREMENT                AVERAGE       MINIMUM       MAXIMUM
-------------------------------------------------------------------------
Signal Level               -20           -20           -20
S/N Ratio                  > 45          > 45          > 45
Carrier Frequency           2001          2001          2001
Phase Modulation           0             0             0
Phase Jitter               0             0             0
Amplitude Modulation       0             0             0
Amplitude Jitter           0             0             0
```

```
                TRANSIENTS
-----------------------------------
MEASUREMENT                  COUNT
-----------------------------------
Phase Hits                     0
Gain Hits                      0
Impulse Noise                  0
Dropouts                       0

-----------------------------------
Insrument Retrains             0
Data Rate Changes       RESULTS NOT APPLICABLE
```

Event Logging

Five commands provide remote control of logging. They are listed here in the order you should use them.

Description	Commands
Select the type of logging you want	LOG
Read the current state of the logging process	LOGS
When did logging start	LSTRT
When did logging stop	LSTPT
How many events have been logged	EVNL

Set the 4948A for event logging with the LOG 3 command (see Page 4-65).

Read the current state of the logging process with the LOGS command.

Command Syntax : LOGS<*ct*>

Response : <state><*rt*> <state> = 1 to 5

<state>	Logging State
1	off
2	imminent
3	autosearch start
4	waiting for time
5	active

To enquire about the log start and stop times, use the LSTRT and LSTPT commands respectively (see Page 4-74 and 4-73 respectively).

Command Syntax : LSTRT<*ct*> for log start time

LSTPT<*ct*> for log stop time

The response to the above commands is similar. The first value returned is an availability flag. In either case, if no time has been recorded, then <validity> = 0 and no time is returned.

Response : <validity><*rt*>
<month>,<day of month>,<hours>,
<minutes>,<seconds><*rt*>

where : <validity> = 0 or 1
<month> = 1 to 12
<day of month> = 1 to 28,29,30 or 31 (range depends on month and year)
<hours> = 0 to 23
<minutes> = 0 to 59
<seconds> = 0 to 59

If <validity> = 0 then there is no recorded time.
If <validity> = 1 then there is a recorded time.

To find out how many events have been logged use the following command:

Command Syntax : EVNL<*cr*>

Response : <event count><*rt*> <event count> = 0 to 1000

Reading the Events Log

There are two commands you can use to read the events log:

- Use the LOGE command to read the most recently logged events up to a selectable maximum of 1000 (see Page 4-66).
- Use the LOGED command to read logged events on a regular basis, ensuring that no events are missed or duplicated. When LOGED is issued the 4948A returns , all events logged since the last LOGED command or since the start of the events log, (see Page 4-68).

The response to the LOGE command is:

<request status><*rt*>
<number of events><*rt*><data block>*

The response to the LOGED command is:

<number of events><*rt*> <data block>*

* A <data block> is returned for each event ie, if the <number of events> = 3, then 3 <data block>s are returned.

Each <data block> is time stamped and each result is accompanied by a qualification byte <qb>. For further information on LOGE and LOGED, see Page 4-66 and 4-68.

Example : Reading the Events Log

```
10    !*************************************************************************
20    !      DISPLAYING THE EVENT LOG USING THE "LOGE" COMMAND VIA HP-IB
30    !*************************************************************************
40    !
50    ! This program retrieves and displays events from the event log. The user
51    ! need only enter the date, time and number of events.
52    !
60    !*************************************************************************
70    !
80    Sc=705              ! The 4948A HP-IB device select code.
90    REMOTE Sc           ! Puts the 4948A in the remote state.
100   CALL Loge(Sc)       ! Call SUBPROGRAM to retrieve events.
110   LOCAL Sc            ! Returns the 4948A to the local state.
120   END
130   !
140   !*************************************************************************
150   !
160   SUB Loge(Sc)
170   !
180   !*************************************************************************
190   !                                 PART 1
200   !      ENTER THE DATE, TIME AND THE NUMBER OF EVENTS YOU WANT DIPLAYED
210   !*************************************************************************
220   !
230     PRINTER IS 1      ! Assigns the CRT as the printer.
240     PRINT "To dump the events log :"
250     PRINT "Enter date ( day, month, year) then press RETURN."
260     INPUT C,B,A       ! Key in date.
270     A=A+1900          ! Converts year (XX) to 19XX.
280     PRINT "Enter time ( hours, minutes, seconds) then press RETURN."
290     INPUT D,E,F       ! Key in date.
300     PRINT "Enter the number of events you want, then press RETURN."
310     INPUT G           ! Key in number of events.
320   !
330   !*************************************************************************
340   !                               PART 2
350   !                         DISPLAY THE EVENT LOG
360   !*************************************************************************
370   !
380   !
390   !************************DIMENSION VARIABLES******************************
400     DIM Month$(12)[10]
410     DIM Header$(20)[30]
420     DIM Res(14)
430     DIM Qual(14)
440   !
450   !*****************************
460   !
470     FOR Month=1 TO 12
480       READ Month$(Month)          ! Fills 12 arrays with months of year
490                                   ! Month$(1) contains  JAN
500     NEXT Month
510   !
520   !*************************REQUEST THE LOG ********************************
530   !
540     OUTPUT Sc;"LOGE "&A&","&B&","&C&","&D&","&E&","&F&","&G
550   !
560   !************************DISPLAY LOG STATUS*******************************
```

```
570     ENTER Sc;H,No_of_events
580     IF H=1 THEN PRINT "No logged results at";D;",";E;",";F;"."
590     IF H=2 THEN PRINT "Time";D;",";E;",";F;"is earlier than the earliest eve
nt in the log."
600     IF H=3 THEN PRINT "Time";D;",";E;",";F;"is in the log."
610     IF H=4 THEN PRINT "Time";D;",";E;",";F;"is later than the latest event i
n the log."
620     PRINT " "
630     PRINT "Number of events to be printed =";No_of_events
640     PRINT " "
650   !
660   !*************************DISPLAY HEADER*****************************
670   !
680     PRINT "Event Time           Alarms                        Transients
    Rx Status"
690     PRINT "-----------  -------------------------    ----------------------
--- ---------"
700     PRINT "              ";
710     FOR N=1 TO 13
720       IF N=8 THEN PRINT "   ";
730       READ Header$(N)
740       PRINT Header$(N);" ";
750     NEXT N
760     PRINT
770     PRINT "-----------  -------------------------    ----------------------
--  ---------"
780 !
790 !**************REMAINDER OF "LOGE" RESPONSE ENTERED INTO VARIABLES**********
800 !
810     FOR X=1 TO No_of_events       ! Keyed in from keyboard.
820       ENTER Sc;Y,M,D,Tim$         ! Reads date and time from instrument.
830       ENTER Sc;Power_status       ! 4948A Power state flag
840       ENTER Sc;Rx_status          ! 4948A Receiver status flag
850       ENTER Sc;Res(1),Qual(1),Res(2),Qual(2),Res(3),Qual(3),Res(4),Qual(4),R
es(5),Qual(5),Res(6),Qual(6),Res(7),Qual(7)  ! Alarms status
860       ENTER Sc;Res(8),Qual(8),Res(9),Qual(9),Res(10),Qual(10),Res(11),Qual(1
1)                                  !  Transients status
870       ENTER Sc;Res(12),Qual(12)   !  Retrains
880       ENTER Sc;Res(13),Qual(13)   !  Data Rate Changes (DRC)
890 !
900 !*****************************DISPLAY EVENTS*******************************
910 !
920       PRINT D;Month$(M)           !  Prints Day and Month.
930       PRINT Tim$;"     ";         !  Prints time.
940       !
950       IF Power_status=2 THEN PRINT "    POWER FAILURE   OR   DEVICE CLEAR
"
960       IF Power_status=3 THEN PRINT "         LOGGING RESUMED        "
970       IF Power_status>1 THEN GOTO Next_log     ! Skips the N=1 to 13 loop.
980       !
990       FOR N=1 TO 13
1000        IF N=8 THEN PRINT "  ";  ! Aligns Transients column.
1010        IF N<8 THEN
1020          GOSUB Format_alarms     ! Format alarm results.
1030          PRINT "   ";            ! Spacing between results.
1040        ELSE
1050          PRINT Res(N);" ";       ! Prints Transient results.
1060        END IF
1070      NEXT N
1080      PRINT "   ";Rx_status       ! Last column after loop ends.
1090      PRINT
1100 Next_log:      !  Goto label if power has been cycled.
1110    NEXT X      !  X is the number of events.
```

```
1120 !
1130 !*************************************************************************
1140 !
1150   GOTO Finish ! Exit when all results are printed
1160 !
1170 !*************************************************************************
1180 !
1190 Format_alarms:! Translates alarm variable
1200    SELECT Res(N)
1210    CASE 0
1220      PRINT "-";          ! Not yet available
1230    CASE 1
1240      PRINT " ";          ! No alarms
1250    CASE 2
1260      PRINT "L";          ! Lower threshold violation
1270    CASE 3
1280      PRINT "U";          ! Upper threshold violation
1290    CASE ELSE
1300      PRINT "*";          !  THIS SHOULDN'T HAPPEN !!!!!!!!!!!!!
1310    END SELECT
1320    RETURN
1330 !
1340 !*************************************************************************
1350 !
1360    DATA JAN,FEB,MAR,APR,MAY,JUN,JUL,AUG,SEP,OCT,NOV,DEC
1370    DATA LEV,S/N,FRQ,PHM,PHJ,AMM,AMJ,PHH,GNH,IMP,DPO,RTR,DRC
1380 !
1390 !*************************************************************************
1400 !
1410 Finish:   ! EXIT LABEL
1420  SUBEND
```

```
1     ! For RS-232-C control the main program shown above is changed in lines
2     ! 80, 90 and 110 - see below.
3     !
4     !
10    !*************************************************************************
20    !    DISPLAYING THE EVENT LOG USING THE "LOGE" COMMAND VIA RS-232-C
30    !*************************************************************************
40    !
50    ! This program retrieves and displays events from the event log. The user
51    ! need only enter the date, time and number of events.
52    !
60    !*************************************************************************
70    !
80    Sc=20               ! The HP98628A interface select code.
90    OUTPUT Sc;"RMT"     ! Puts the 4948A in the remote state.
100   CALL Loge(Sc)       ! Call SUBPROGRAM to retrieve events.
110   OUTPUT Sc;"LCL"     ! Returns the 4948A to the local state.
120   END
130   !
140   ! ************************************************************************
150   ! *     Before you can run a program via the RS-232-C interface, the     *
160   ! *     controller and 4948A must be compatible - see CONFIGURING THE    *
170   ! *     4948A FOR RS-232-C REMOTE CONTROL in section 3 of the manual.    *
180   ! ************************************************************************
```

```
Time 9 , 0 , 0 is earlier than the earliest event in the log.

Number of events going to be printed = 12
```

Event Time	Alarms							Transients						Rx Status
	LEV	S/N	FRQ	PHM	PHJ	AMM	AMJ	PHH	GNH	IMP	DPO	RTR	DRC	
21 OCT 09,06,03	-	-	-	-	-	-	-	0	0	0	0	0	0	2
21 OCT 09,06,04	-	-	-	-	-	-	-	0	0	0	0	0	0	6
21 OCT 09,06,07	POWER FAILURE OR DEVICE CLEAR													
21 OCT 09,06,36	LOGGING RESUMED													
21 OCT 09,06,37	-	-	-	-	-	-	-	0	0	0	0	0	0	6
21 OCT 09,06,42	-	-	-	-	-	-	-	0	0	0	0	0	0	9
21 OCT 09,07,22								0	0	0	0	0	0	10
21 OCT 09,08,10								0	0	1	1	0	0	10
21 OCT 09,08,14								0	0	0	1	0	0	10
21 OCT 09,08,16	-	-	-	-	-	-	-	0	0	0	0	1	0	6
21 OCT 09,08,21	-	-	-	-	-	-	-	0	0	0	0	0	0	9
21 OCT 09,09,01								0	0	0	0	0	0	10

Setting the 4948A Real Time Clock

Set the 4948A real time clock using the CLOCK command.

Command Syntax : `CLOCK <year>,<month>,<day of month>,`
`<hours>,<minutes>,<seconds><cr>`

where : <year> = 1901 to 2099
<month> = 1 to 12
<day of month> = 1 to 28, 29, 30 or 31 (range depends on month and year)
<hours> = 0 to 23
<minutes> = 0 to 59
<seconds> = 0 to 59

Use the TIME? command to read back the time of the 4948A real time clock.

Command Syntax : `TIME?<cr>`

Response : `<string><rt>` e.g. <string> = "17th Feb 1986 11:16:47"

Reading the 4948A Current Settings

Enquiries about the current setup or measurements may be made by using the enquire ? commands (see table on Page 4-52 for complete list of commands).

Information about errors is returned if you use the ERR? command (see Page 4-60). The ERR? command can be used to return errors as they occur (by using a SRQ/interrupt on errors routine) - useful when developing programs for the 4948A.

To enquire about instrument status use the STB? command (see Page 4-90). This command is intended for RS-232-C interface.

11

12

Example

To check the receiver termination issue the "RCVT?" command. If the 4948A receiver is bridged, RCVT 1 is returned and if terminated, RCVT 2 is returned.

Other Commands

BEEP causes the 4948A audio monitor to "beep" (see Page 4-54).

CAL enable a string of up to 40 characters to be programmed into continuous memory - is primarily intended for calibration or similar data (see Page 4-55).

RSTT resets the gain hit, phase hit, impulse noise and dropout counters and also resets the transient timer.

RMT causes the 4948A to go into the REMOTE state with local lockout on (see Page 4-84). This command is only available via the RS-232-C interface.

LCL returns the 4948A to LOCAL state - clears local lockout and enables the instrument to accept commands from the front panel. This command is only available via the RS-232-C interface.

DSP enables a controller to display up to 40 characters on a specific line of the 4948A front panel display (see Page 4-59).

KEY? reads the front panel keys (see Page 4-63) when the 4948A front panel is suspended by the DSP command. The key-code memory is reset to 0 when the 4948A is returned to normal operation by the RSTP command (see Page 4-87).

ID? cause the 4948A to return its identification string (see Page 4-62).

OPT? reads the options in the 4948A.

REV? enables the controller to read the instruments firmware revision code (see Page 4-83).

CHCK? is primarily intended as an integrity check of the instruments responses and is intended for RS-232-C users only.

Input/Output Data Formats

Numeric data is formatted in one of three ways.

1. Signed integers - numbers which contain no decimal point, e.g. +8, 10, -137 or 2804.

2. Signed numbers with an embedded decimal point, e.g. .01, +0.26, -1.67, 5.

3. Signed numbers with an embedded decimal point and a signed exponent, e.g. 0.5E+2, +2.1E-3 or -3.0E+6.

A positive number is assumed if there is no sign. The number of digits making up a number depends on the parameter being sent or returned.

For specific data formats, see individual commands contained on Pages 4-54 to 4-94.

Status Reporting

To find out the current status of the instrument you can interrogate the 4948A `primary status byte` register (see Page 4-46). There are three ways to access the `primary status byte` using the HP-IB interface, and only one way if your interface is RS-232-C. The table below lists the ways you can access the `primary status byte`.

How You Interrogate Primary Status Byte	Interface HP-IB	Interface RS-232-C
Poll using STB? command (see Page 4-90).	✓	✓
Serial poll (SPOLL).	✓	
Use a service request (SRQ) interrupt routine.	✓	

See `Demonstration Programs` for more details (see Pages 4-48 to 4-52).

Service Request (SRQ)/Interrupt Routine *(HP-IB only)*

To get your SRQ/Interrupt Routine working:

- Select the condition(s) you want the 4948A to request service on, by using the `PON, RQS, MSCE, SSAE` and `TRAE` commands. - See Commands in Alphabetical Order, Page 4-52.
- Specify the action you want the controller to take when the 4948A issues an `SRQ` by using the controller dependent `ON INTR` (on interrupt) and `ENABLE INTR` BASIC statements in your program.
- Acquire the `primary status byte` by using the controller dependent `SPOLL` (serial poll) BASIC statement.

Device Clear on RS-232-C Interface

The 4948A performs a device clear after it detects a BREAK signal from the controller. The device clear action is performed at the end of the BREAK signal (the device clear is similar to an HP-IB device clear, see Page 3-6).

On the HP200/300 series controllers fitted with the HP98628A Interface, a BREAK signal is sent (using HP BASIC) by sending.

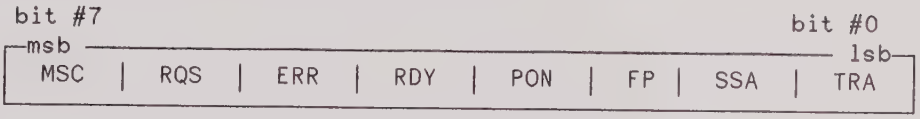
```
CONTROL 20,6;1
WAIT 2
```

The WAIT ensures commands cannot be issued until 2 seconds after the device clear. If the WAIT was not introduced, commands could be lost due to the device clear. The duration of the BREAK signal is determined by CONTROL register 39 (on the HP98628A) and should be set to its default value.

It is recommended you include a BREAK/device clear in your program immediately after the data link is established and should precede your first message to the 4948A.

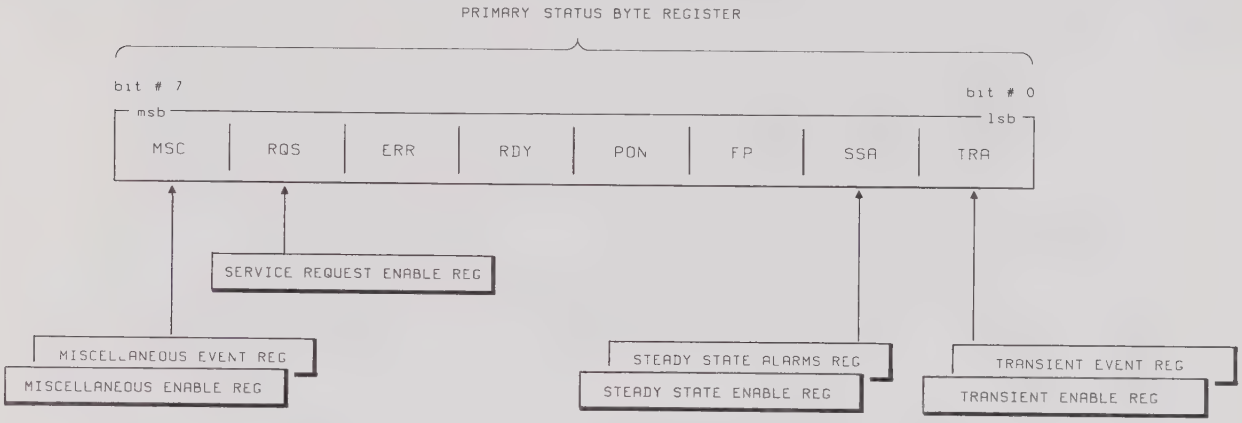
Primary Status Byte

The 4948A status information is contained in the 8-bit **primary status byte.**



Bit#	Mnemonic	Status
7	MSC	**Miscellaneous events summary:** This bit is set when one or more enabled bits in the miscellaneous events register are set, and is reset when all enabled bits in the miscellaneous event register are reset.
6	RQS	**Request Service:** This bit is set when the 4948A requests service and is reset when a serial poll is performed.
5	ERR	**Error Queue:** This bit is set when an error code is inserted into the error queue and reset when all error codes have been read and the queue becomes empty.
4	RDY	**Ready for Output:** This bit is set when the 4948A has a response ready and reset when the controller completes reading out the response. This bit can be useful in HP-IB program development, since serial poll may take place at anytime. When the **primary status** byte is returned in response to STB? command, this bit will always have a fixed value.
3	PON	**Power On:** This bit is set once the instrument has turned on and completed its power-on checks and can only be reset by a "device clear", "selected device clear" a CLR or RST command.
2	FPS	**Front Panel Service Request:** In normal operation this bit is set if the front panel LOCAL key is pressed, whether or not LOCAL LOCKOUT is in force. If front panel operation has been suspended by the DSP command then the FPS bit is set if any front panel key (excluding the LIGHT key) is pressed. In either case the bit is reset by reading the keycode; see the KEY? command for details. The bit is also reset by the DSP and RSTP commands.
1	SSA	**Steady-State Alarm Events Summary:** This bit is set when one or more enabled bits in the steady-state alarm events register are set and is reset when all enabled bits (see MSE) are reset.
0	TRA	**Transient Events Summary:** This bit is set when one or more enabled bits in the transients events register are set, and is reset when all enabled bits (see MSC) are reset.

The primary status byte register has other registers associated with it, see the illustration below.



Enabling Service Requests

The **service request register** is an 8-bit register in which each bit corresponds to a bit in the primary status byte register. Use the RQS command to set the SRQ (service request) mask, and the query form RQS? to read it.

Command Syntax : RQS <mask><*cr*> <mask> = 0 to 255 (denary sum of bits to be set)

RQS?<*cr*> returns RQS <mask><*cr*>

Bit	<mask>	Meaning
7	128	Miscellaneous events summary
6	64	-
5	32	Error bit
4	16	Ready bit
3	8	Power on bit
2	4	Front panel services request
1	2	Steady state alarms summary
0	1	Transient events summary

Miscellaneous Conditions and Events

The `miscellaneous condition register` contains the current condition of some measurement processes. This 8-bit register is read by issuing the MSCC? command.

Command Syntax : MSCC?<*cf*>

Response : <register><*rf*>

Bit	<register>	Condition
7	128	New data spectrum results available
6	64	All measurements available
5	32	-
4	16	-
3	8	-
2	4	-
1	2	-
0	1	-

This command can be used for example to monitor the availability of data spectrum results without actually having to read them. For more details on the meaning of these bits, see MSCC? command (Page 4-75).

The `miscellaneous events register` records the occurrence of some events related to the measurement process. When bits are set in this 8-bit register, they remain set until read by a controller even if they no longer reflect the current status of an event. To read the content of the register issue the MSC? command.

Command Syntax : MSC?<*cf*>

Response : <register><*rf*>

Bit	<register>/<mask>	Event
7	128	New data spectrum results available
6	64	All measurement available
5	32	Logging period complete
4	16	-
3	8	-
2	4	-
1	2	-
0	1	-

Bits 5, 6 and 7 can be used to cause a service request.

To report miscellaneous events using the primary status byte (MSC bit), you must first set up the events you want reported in the `miscellaneous events enable register`. The 8 bits of this register correspond

to the 8 bits of the **miscellaneous events register** (see table above). To setup the miscellaneous events enable mask, use the MSCE command.

Command Syntax : MSCE <mask><*cf*>

The MSCE/MSC commands can be used, for example, to cause an SRQ when spectrum results are available. For more detail on the meaning of these bits see the MSC? command (Page 4-75).

Steady State Alarm Events

During event logging the **steady state alarm events register** records the occurrence of threshold alarm events for all the steady state measurements. When bits are set in this 16-bit register, they remain set until read by a controller even if they no longer reflect the current status of an event. To read the content of the register issue the SSA? command.

Command Syntax : SSA?<*cf*>

Response : <register><*rf*>

Bit	<register>/<mask>	Alarm Condition
15	32768	-
14	16384	Upper signal level alarm
13	8192	Lower signal level alarm
12	4096	Signal/noise ratio alarm
11	2048	Upper carrier frequency alarm
10	1024	Lower carrier frequency alarm
9	512	Phase modulation alarm
8	256	Phase jitter alarm
7	128	Amplitude modulation alarm
6	64	Amplitude jitter alarm
5	32	-
4	16	-
3	8	-
2	4	-
1	2	-
0	1	-

To report steady state alarm events using the primary status byte (SSA bit), you must first set up the alarms you want reported, in the **steady state alarm enable events register**. The 16 bits of this register correspond to the 16 bits of the **steady state alarm events register** (see table). To set up the steady state alarm events mask, use the SSAE command.

Command Syntax : SSAE <mask><*cf*>

See table above for <mask>

Transient Events

The `transient event register` records the occurrence of measured transient impairments and other transient events. When bits are set in this 8-bit register, they remain set until read by a controller even if they no longer reflect the current status of an event. To read the content of the register issue the TRA? command.

Command Syntax : TRA?<*cf*>

Response : <register><*rf*>

Bit	<register>/<mask>	Transient Event
7	128	Phase hit(s)
6	64	Gain hit(s)
5	32	Impulse noise
4	16	Dropout(s)
3	8	-
2	4	-
1	2	Instrument retrains
0	1	Data rate changes

To report transient events using the primary status byte (TRA bit), you must first set up the transient events you want reported in the `transient event enable register`. The 8 bits of this register correspond to the 8 bits of the `transient events register` (see table above). To set up the transient event mask, use the TRAE command.

Command Syntax : TRAE <mask><*cf*>

See table above for <mask>

Power-fail Recovery - Preserving RQS and Event Masks

The PON command allows the SRQ and event enable masks to be preserved at power-on and after "device clear", "selected device clear", CLR or RST commands.

Command Syntax : PON <control><*cf*>

When <control> is set to 1, the service request and event enable masks which were programmed prior to the power down or "device clear" will be preserved. If <control> is set to 0, the RQS mask is initialized to 32 (ERR bit enabled), and clears the MSCE, SSAE and TRAE masks to zero.

Demonstration Programs

Before looking at the three demonstration programs (written in BASIC for a HP200/300 series controller) you should be aware of the following items.

- Command syntax
- Input/Output Data Format
- Controller dependent statements (OUTPUT, ENTER, INTERRUPT and SPOLL etc).

If you run Programs 1 to 3 via the HP-IB interface, set the 4948A address to 5 (see page 3-4).

These programs will run on a HP200/300 controller via the HP-IB. Only Program 1 can be run via the RS-232-C interface.

The three programs are very simple and are only intended to demonstrate status reporting:

STB? command ..... Program 1
SPOLL command ..... Program 2
SRQ Interrupt Routine ..... Program 3

These programs monitor for `when all measurements available` and for when a `logging period is complete`.

A typical response to the three programs is shown below.

```
ALL MEASUREMENTS AVAILABLE
 1 LOGGING PERIOD(S) COMPLETE
 2 LOGGING PERIOD(S) COMPLETE
4948A STOPPED AFTER 2 PERIODS
```

Program 1

```
10    !*************************************************************************
20    ! INTERROGATING THE PRIMARY STATUS BYTE USING THE "STB?" COMMAND VIA HP-IB
30    !*************************************************************************
40    !
50    ! This program repeatedly uses the STB? command to interrogate the MSC bit
60    ! of the primary status byte which is set when all measurements become
70    ! avilable or when logging period is complete.
80    !
90    !*************************************************************************
100   !
110   Sc=705                          ! The 4948A HP-IB device select code.
120   REMOTE Sc                       ! Puts the 4948A into the remote state.
130   CALL Status(Sc)                 ! Call SUBPROGRAM to interrogate.
140   LOCAL Sc                        ! Returns the 4948A to its local state.
150   END
160   !
170   !*************************************************************************
180   !
190   SUB Status(Sc)
200     PRINTER IS 1                  ! Assigns the CRT as printer.
210     PRINT "Enter the number of periods you are interested in."
220     INPUT No_of_periods           ! Key in the number of periods.
230     OUTPUT Sc;"MSCE 96"           ! Set miscellaneous mask.
240     Periods_so_far=0
250     REPEAT                        ! This loop checks for end of test.
260       GOSUB Check_status          ! This GOSUB checks the MSC bit.
270       OUTPUT Sc;"MSC?"            ! Request miscellaneous event reg value.
280       ENTER Sc;Misc_byte          ! Enter value.
290       SELECT Misc_byte            ! Check which event has occurred.
300       CASE 64             ! If 64 returned then all measurements available.
310         PRINT "ALL MEASUREMENTS AVAILABLE"
320       CASE 32               ! If 32 returned then logging period complete.
330         Periods_so_far=Periods_so_far+1
340         PRINT Periods_so_far;"LOGGING PERIOD(S) COMPLETE"
350       END SELECT
360     UNTIL Periods_so_far=No_of_periods
370     OUTPUT Sc;"STOP"              ! Stopped 4948A at end of test.
380     PRINT "4948A STOPPED AFTER";No_of_periods;"PERIOD(S)."
390     SUBEXIT
391     !
392     !
400 Check_status:    !
410     SET TIME 0                    ! Reset lapsed time to zero.
430     REPEAT                        ! This loop repeatedly polls the 4948A.
435       DISP "WAITING TILL END OF LOGGING PERIOD  ";TIME$(TIMEDATE)
440       OUTPUT Sc;"STB?"            ! Poll primary status byte.
450       ENTER Sc;Stat_byte          ! Enter primary status byte value.
460     UNTIL BIT(Stat_byte,7)        ! Check MSC summary bit.
470     RETURN
480   SUBEND


1     ! For RS-232-C control the main program above is changed in lines
2     ! 110, 120 and 140 -see below.
3     !
4     !
10    ! *************************************************************************
20    !INTERROGATING THE PRIMARY STATUS BYTE USING THE "STB?" COMMAND VIA RS-232-C
30    ! *************************************************************************
40    !
50    ! This program repeatedly uses the STB? command to interrogate the MSC bit
60    ! of the primary status byte which is set when all measurements become
70    ! avilable or when logging period is complete.
```

```
80    !
90    !*************************************************************************
100   !
110   Sc=20                          ! The 4948A device select code.
120   OUTPUT Sc;"RMT"                ! Puts the 4948A into the remote state.
130   CALL Status(Sc)                ! Call SUBPROGRAM to interrogate.
140   OUTPUT Sc;"LCL"                ! Returns the 4948A to its local state.
150   END
160   !
190   ! ***********************************************************************
200   ! *   Before you can run a program via the RS-232-C interface, the    *
210   ! *   controller and 4948A must be compatible - see CONFIGURING THE   *
220   ! *   4948A FOR RS-232-C REMOTE CONTROL in section 3 of the manual.   *
230   ! ***********************************************************************
```

Program 2

```
10    !*************************************************************************
20    ! INTERROGATING THE PRIMARY STATUS BYTE USING THE "SPOLL" COMMAND VIA HP-IB
30    !*************************************************************************
40    !
50    ! This program repeatedly uses the SPOLL command to interrogate the MSC
60    ! bit of the primary status byte which is set when all measurements become
70    ! avilable or when logging period is complete.
80    !
90    !*************************************************************************
100   !
110   Sc=705                         ! The 4948A HP-IB device select code.
120   REMOTE Sc                      ! Puts the 4948A into the remote state.
130   CALL Status(Sc)                ! Call SUBPROGRAM to interrogate.
140   LOCAL Sc                       ! Returns the 4948A to its local state.
150   END
160   !
170   !*************************************************************************
180   !
190   SUB Status(Sc)
200     PRINTER IS 1                 ! Assigns the CRT as printer.
210     PRINT "Enter the number of periods you are interested in."
220     INPUT No_of_periods          ! Key in the number of periods.
230     OUTPUT Sc;"MSCE 96"          ! Set miscellaneous mask.
240     Periods_so_far=0
250     REPEAT                       ! This loop checks for end of test.
260     GOSUB Check_status           ! This GOSUB checks the MSC bit.
270       OUTPUT Sc;"MSC?"           ! Request miscellaneous event reg value.
280       ENTER Sc;Misc_byte         ! Enter value.
290       SELECT Misc_byte           ! Check which event has occurred.
300       CASE 64              ! If 64 returned then all measurements available.
310         PRINT "ALL MEASUREMENTS AVAILABLE"
320       CASE 32               ! If 32 returned then logging period complete.
330         Periods_so_far=Periods_so_far+1
340         PRINT Periods_so_far;"LOGGING PERIOD(S) COMPLETE"
350       END SELECT
360     UNTIL Periods_so_far=No_of_periods
370     OUTPUT Sc;"STOP"         ! Stop 4948A at end of test.
380     DISP " "
390     PRINT "4948A STOPPED AFTER";No_of_periods;"PERIODS"
400     SUBEXIT
410     !
420     !
430 Check_status:      !
440     SET TIME 0                   ! Reset lapsed time to zero.
450       REPEAT
```

```
460       DISP "WAITING TILL END OF LOGGING PERIOD  ";TIME$(TIMEDATE)
470         S=SPOLL(705)              ! Serial poll the 4948A.
480       UNTIL BIT(S,7)              ! Check MSC bit.
490       RETURN
500     SUBEND
```

Program 3

```
10      !*************************************************************************
20      !  INTERROGATING THE PRIMARY STATUS BYTE USING AN SRQ/INTERRUPT ROUTINE.
30      !*************************************************************************
40      !
50      ! This program uses an SRQ/interrupt routine to interrogate the MSC
60      ! bit of the primary status byte which is set when all measurements become
70      ! avilable or when logging period is complete.
80      !
90      !*************************************************************************
100     !
110     Sc=705                          ! The 4948A HP-IB device select code.
120     REMOTE Sc                       ! Puts the 4948A into the remote state.
130     CALL Status(Sc)                 ! Call SUBPROGRAM to interrogate.
140     LOCAL Sc                        ! Returns the 4948A to its local state.
150     END
160     !
170     !*************************************************************************
180     !
190     SUB Status(Sc)
200       PRINTER IS 1                  ! Assigns the CRT as printer.
210       PRINT "Enter number of periods of interest then press RETURN."
220       INPUT No_of_periods
221       Periods_so_far=0
230       OUTPUT Sc;"MSCE 96"           ! Set miscellaneous mask.
240       OUTPUT Sc;"RQS 128"           ! Set service request mask.
250       OUTPUT Sc;"PON 1"             ! Protects SRQ & event masks.
270       ON INTR 7 GOSUB Service       ! Call SRQ handler on interrupt.
271       SET TIME 0                    ! Set lapsed time to zero.
280       ENABLE INTR 7;2               ! Interrupt interface 7 on SRQ.
281       DISP "WAITING TILL END OF LOGGING PERIOD ";TIME$(TIMEDATE)
283         IF Periods_so_far=No_of_periods THEN
284           OUTPUT Sc;"STOP"
285           DISP ""
287           PRINT "4948A STOPPED AFTER";No_of_periods;"PERIOD(S)"
288           SUBEXIT           ! Goto end of SUBPROGRAM.
289         END IF
290       GOTO 280                      ! Idle loop.
300       !
310       !
320   Service:S=SPOLL(705)              ! Serial poll the 4948A.
330       IF BIT(S,7) THEN              ! Check MSC bit.
340         OUTPUT Sc;"MSC?"            ! Request miscellaneous event reg value.
350         ENTER Sc;Misc_byte          ! Enter value.
351         SET TIME 0                  ! Resets lapsed time to zero.
360         SELECT Misc_byte            ! Check which event has occurred.
370         CASE 64             ! If 64 returned then all measurements available.
380           PRINT "ALL MEASUREMENTS AVAILABLE"
390         CASE 32             ! If 32 returned then logging period complete.
391           Periods_so_far=Periods_so_far+1
400           PRINT Periods_so_far;"LOGGING PERIOD COMPLETE"
430         END SELECT
441       END IF
450       RETURN
460     SUBEND
```

Commands In Alphabetical Order

Mnemonic	Function	Page
AMJT, AMJT?	Amplitude Jitter Threshold	4-54
AMMT, AMMT?	Amplitude Modulation Threshold	4-54
BEEP	Cause the Instrument to BEEP	4-54
CAL, CAL?	Calibration String	4-55
CHCK?	Checksum Query	4-55
CLOCK, CLOCK?	Clock Setting	4-55
CLR	Device Clear	4-56
CRFLT, CRFLT?	Carrier Frequency Lower Threshold	4-56
CRFUT, CRFUT?	Carrier Frequency Upper Threshold	4-57
CURR	Current Results	4-57
DRTN, DRTN?	Period Duration	4-58
DSP, DSP?	Display String on Front Panel	4-58
DTSP	Data Spectrum	4-59
ERR?	Error Queue Query	4-60
EVNL	Events Logged	4-60
FREQ, FREQ?	Transmit Frequency	4-61
GNHT, GNHT?	Gain Hit Threshold	4-61
ID?	Identification Query	4-62
IMNT, IMNT?	Impulse Noise Threshold	4-62
INPUT, INPUT?	Receiver Input	4-62
KEY?	Front Panel Key Query	4-63
LCL	Local	4-64
LEVEL, LEVEL?	Transmit Level	4-64
LGFR, LGFR?	Log from Start/Time Control	4-64
LOG, LOG?	Log Type	4-65
LOGE	Logged Events	4-66
LOGED	Logged Events Delta	4-68
LOGP	Logged Periods	4-68
LOGPD	Logged Periods Delta	4-71
LOGS	Logging State	4-72
LSTPT	Log Stop Time	4-73
LSTRT	Log Start Time	4-74
MDMS, MDMS?	Modem Selection Method	4-74
MSC?	Miscellaneous Events Query	4-75
MSCC?	Miscellaneous Conditions Query	4-75
MSCE, MSCE?	Miscellaneous Events Enable	4-76
OPRM, OPRM?	Operating Mode	4-77
OPT?	Option Query	4-77
PHHT, PHHT?	Phase Hit Threshold	4-78
PHJT, PHJT?	Phase Jitter Threshold	4-78
PHMT, PHMT?	Phase Modulation Threshold	4-79
PON, PON?	Power ON Srq	4-79
PRDL	Periods Logged	4-80

Mnemonic	Function	Page
RCVI, RCVI?	Receive Impedance	4-80
RCVM, RCVM?	Receive Modem	4-81
RCVS	Receiver Status	4-82
RCVT, RCVT?	Receive Termination	4-83
REV?	Revision Query	4-83
RMSS	Receive Modem Search State Query	4-84
RMT	Remote (with local lockout)	4-84
RQS, RQS?	Request Service Enable	4-85
RST	Reset Instrument	4-85
RSTP	Restore Page	4-87
RSTT	Reset Transients and Timer	4-87
SER?	Serial Number Query	4-87
SGLLT, SGLLT?	Signal Level Lower Threshold	4-88
SGLUT, SGLUT?	Signal Level Upper Threshold	4-88
SNRT, SNRT?	Signal to Noise Ratio Threshold	4-88
SSA?	Steady State Alarm Events Query	4-89
SSAE, SSAE?	Steady State Alarm Events Enable	4-89
START, START?	Instrument START	4-90
STB?	Status Byte Query	4-90
STOP, STOP?	Instrument STOP	4-91
TIME?	Time String Query	4-91
TRA?	Transient Events Query	4-92
TRAE, TRAE?	Transient Events Enable	4-92
TRNI, TRNI?	Transmit Impedance	4-93
TRNM, TRNM?	Transmit Modem	4-93
TRNS, TRNS?	Transmitter Enable Control	4-94

AMJT .. .. Amplitude Jitter Threshold

Command Syntax : AMJT <threshold><*ct*> <threshold> = 4 to 20 (% pk)

AMJT?<*ct*>

These commands set or read the amplitude jitter alarm threshold. You cannot change the threshold if the 4948A is **logging**.

If you are event logging and the receiver is in the **all measurements available** state then, subject to hysteresis, a positive transition through the selected threshold value will cause an event to be recorded.

The enquiry command AMJT? will cause the 4948A to return the command mnemonic and the current threshold value.

Response : AMJT <threshold><*rt*>

e.g. If the amplitude jitter threshold is set at 8%, the AMJT? command returns AMJT 8.

AMMT .. .. Amplitude Modulation Threshold

Command Syntax : AMMT <threshold><*ct*> <threshold> = 4 to 20 (% pk)

AMMT?<*ct*>

These commands set or read the amplitude modulation alarm threshold. You cannot change the threshold if the 4948A is **logging**. If you are event logging and the receiver is in the **all measurements available** state then, subject to hysteresis, a positive transition through the selected threshold value will cause an event to be recorded.

The enquiry command AMMT? will cause the 4948A to return the command mnemonic and the current threshold value.

Response : AMMT <threshold><*rt*>

e.g. If the amplitude modulation threshold is set at 8%, the AMMT? command returns AMMT 8.

BEEP .. .. Causes a Front Panel Beep

Command Syntax : BEEP<*ct*>

This command causes the 4948A to "beep".

CAL .. .. Calibration String

Command Syntax : CAL <string><*ct*> <string> = "up to 40 characters"

CAL?<*ct*>

These commands allow you to write a string of up to 40 characters into the 4948A continuous memory or read the string from continuous memory. If the string contains non-printing characters (ASCII 0 to ASCII 31 and ASCII 127) then these are characters are replaced by spaces.

For the double quotes characters to appear inside a string it must be repeated.

You can include any information you wish but it is primarily intended for calibration data.

e.g. CAL "CAL ON ""ALPHA"" 12 NOV 86"

The enquiry command CAL? returns the string from continuous memory. Double quotes characters inside the string are repeated. If the calibration string has not previously been programmed or the continuous memory has been re-initialised then a null string (" "<*rt*>) is returned.

CHCK .. .. Checksum Query

Command Syntax : CHCK?<*ct*>

This command causes the 4948A to output the modulo 256 sum of the 7-bit ASCII codes of the characters comprising the most recent response from the instrument including the response terminator symbol(s).

This is primarily intended for users of the RS-232-C interface as an integrity check of the instrument's responses.

Response : <checksum><*rt*> <checksum> = 0 to 255

CLOCK .. .. Setting and Reading the Clock

Command Syntax : CLOCK <year>,<month>,<day of month>,<hours>,
<minutes>,<seconds><*ct*>

<year> = 1901 to 2099
<month> = 1 to 12
<day of month> = 1 to 28, 29, 30 or 31
<hours> = 1 to 23
<minutes> = 1 to 59
<seconds> = 1 to 59

CLOCK?<*rt*>

The enquiry command CLOCK? returns the command mnemonic and the current time.

Response : CLOCK <year>,<month>,<day of month>,<hours>,<minutes>,<seconds><*rt*>

e.g. If the clock reading is 1986, June 4th, 13:40:30, the CLOCK? command returns CLOCK 1986,6,4,13,40,30

CLR .. .. Device Clear

Command Syntax : CLR<*ct*>

The CLR command causes the 4948A to perform a "device clear" . CLR has an advantage over the HP-IB multiline commands DCL and SDC in that it can appear in a multi-command line without the remainder of the line being lost in the device clear, but it is primarily intended for use via the RS-232-C interface.

All error conditions and status registers are cleared and depending on the state of the "power-on mask control bit" the request service and event enable registers may be cleared. Otherwise, the 4948A programming is not changed. A "device clear" is regarded as a power fail if the 4948A is data logging.

CRFLT .. .. Carrier Frequency Lower Threshold

Command Syntax : CRFLT <threshold><*ct*> <threshold> = 401 to (upper threshold -1) (Hz)

CRFLT?<*ct*>

These commands set or read the carrier frequency lower threshold. You cannot change the threshold if you are logging.

If you are event logging and the receiver is in the all measurements available state then, subject to hysteresis, a negative transition through this threshold value will cause an event to be recorded.

The enquiry command CRFLT? will cause the 4948A to return the command mnemonic and the current threshold value.

Response : CRFLT <threshold><*rt*>

e.g. If the carrier frequency lower threshold is 500Hz, the CRFLT? command returns CRFLT 500.

CRFUT .. .. Carrier Frequency Upper Threshold

Command Syntax : `CRFUT <threshold><cr>` <threshold> = (lower threshold +1) to 2809 (Hz)

`CRFUT? <cr>`

These commands set or read the carrier frequency upper threshold. You cannot change the threshold if the 4948A is `logging`.

If you are event logging and the receiver is in the `all measurements available` state then, subject to hysteresis, a positive transition through this threshold value will cause an event to be recorded.

The enquiry command `CRFUT?` will cause the 4948A to return the command mnemonic and the current threshold value.

Response : `CRFUT <threshold><rl>`

e.g. If the carrier frequency upper threshold is 1900Hz, the `CRFUT?` command returns `CRFUT 1900`.

CURR .. .. Current Results

Command Syntax : `CURR<cr>`

This command reads the current set of results except Data Spectrum (see `DTSP`). All values returned come from the same time sample. You only get current results if the 4948A is in the `receive modem signal` or `transmit/receive tone` operating modes. Returned with each result is a qualification byte `<qb>` (see page 4-13/14), if `<qb>` ≠ 0 the result is unavailable or not yet available.

Response :		
	`<receiver state><rl>`	<receiver state> = see `RCVS` on Page 4-62
	`<signal level>,<qb><rl>`	<signal level> = -51.0 to 1.0 (dBm)
	`<s/n ratio>,<qb><rl>`	<s/n ratio> = 13.0 to 45.0 (dB)*
	`<carrier frequency>,<qb><rl>`	<carrier frequency> = 395.0 to 2815.0 (Hz)*
	`<phase modulation>,<qb><rl>`	<phase modulation> = 0.0 to 35.0 (deg pk-pk)
	`<phase jitter>,<qb><rl>`	<phase jitter> = 0.0 to 35.0 (deg pk-pk)
	`<amplitude modulation>,<qb><rl>`	<amplitude modulation> = 0.0 to 25.0 (% pk)
	`<amplitude jitter>,<qb><rl>`	<amplitude jitter> = 0.0 to 25.0 (% pk)
	`<hr>,<mins>,<secs><rl>`	
	`<phase hits>,<qb>,`	<phase hits> = 0 to 9999
	`<gain hits>,<qb>,`	<gain hits> = 0 to 9999
	`<impulse noise>,<qb>,`	<impulse noise> = 0 to 9999
	`<dropouts>,<qb><rl>`	<dropouts> = 0 to 9999
	`<instrument retrains>,<qb><rl>`	<instrument retrains> = 0 to 9999
	`<data rate changes>,<qb><rl>`	<data rate changes> = 0 to 9999

* As for other measurements, a value of zero is returned if the result is not applicable or not yet available (see Page 4-14).

DRTN .. .. Logging Period Duration

Command Syntax : DRTN <selector><*ct*> <selector> = 1 to 4

DRTN?<*ct*>

These commands select or read the logging period duration. You can only set the period duration if the 4948A is STOPPED and in either receive modem signal or transmit/receive tone operating modes. The period durations you can select are shown in the following table.

<selector>	Period Duration
1	5 minutes
2	15 minutes
3	30 minutes
4	60 minutes

The enquire command DRTN? will cause the 4948A to return the command mnemonic and the current period duration setting.

Response : DRTN <selector><*rt*>

e.g. If the logging period duration is 15 minutes, the DRTN? command returns DRTN 2.

DSP .. .. Front Panel Display

Command Syntax : DSP <line>,<text><*ct*> <line> = 1 to 4
<text> = "string of up to 40 characters"

DSP?<*ct*>

These commands write a string of up to 40 characters on a specific line on the front panel display or read the front panel display. If less than 40 characters are in the string then spaces will be used to fill the remainder of the line. For the double quotes characters to appear inside the string, it must be repeated.

If you write to the front panel display, the DSP command resets the response to the KEY? command to 0 and resets the FPS bit in the primary status byte.

NOTE

To resume normal operation after using the DSP command, it is essential you use the RTSP command to restore the original page.

The table below describes the characters produced by codes 0 to 127.

ASCII Code	Character
0	□
1	■
2	▸
3	space
4	◆
5	≈
6	±
7	hp
0-31	space
32-125	standard ASCII characters
126	→
127	←

The enquiry command DSP? causes the 4948A to return the contents of the front panel display

Response : <display line 1><*rt*>
<display line 2><*rt*>
<display line 3><*rt*>
<display line 4><*rt*>

Where each line is 40 characters enclosed in double quotes, except that double quotes characters inside the line are repeated.

DTSP .. .. Data Spectrum

Command Syntax : DTSP<*ct*>

This command reads the most recently computed and stored data spectrum results when the 4948A is in the receive modem signal mode. The data spectrum calculation is performed for the first time when the 4948A reaches the all measurements available state and thereafter once per minute.

If the stored data spectrum results are not read, they are overwritten when the next set of results become available i.e., results are updated every minute after the all measurements available state is reached. (If the stored results are being read remotely at that moment, then the update does not occur.)

The DTSP command causes the 4948A to return a <new result> flag which, if 1, lets you know that a new data spectrum is available and follows on with 33 sets of results (see DTSP response below). Each result is also accompanied by a qualification byte <qb> (see Page 4-14). If <new results> = 0 then no new data spectrum is available and no further data is returned. <new results> is cleared when data is read. This means that each new set of results can only be read once. Data spectrum results are not logged. However, they may be read as usual when the 4948A is logging, and if still available may be read (once) after the 4948A is stopped.

See also the MSCC? and MSC? commands.

Response : <new results><rt>
<freq>,<atten>,<qb>,<delay>,<qb><rt>*

* If present this part of the response repeats 33 times.

<new result> = 0 or 1
<freq> = 395.0 to 2815.0 (Hz)
<atten> = -18.0 to +18.0 (dB)
<delay> = -9.0 to +9.0 (ms)

ERR? .. .. Error Queue Enquiry

Command Syntax : ERR?<ct>

This command reads the error code from the 4948A error queue. The oldest error code is returned first, ie first in first out (FIFO). When you read the error code it is removed from the queue. It is recommended that you repeatedly read the error codes until the queue is empty, ie until 0 is returned.

The ERR bit of the primary status byte is set when an error is detected and reset when the most recent error is read and the queue becomes empty. If the ERR bit is also enabled to request service, then the SRQ is de-asserted when the queue becomes empty.

The response to the ERR? command is given below.

Response : <error code><rt> <error code> = -32,768 to 32,767

A list of error codes is contained in Appendix A.

EVNL .. .. Events Logged

Command Syntax : EVNL<ct>

When the 4948A is event logging this command reads the total number of events recorded.

The response to the EVNL command is given below.

Response : <event count><rt> <event count> = 0 to 1000

FREQ .. .. Transmit Frequency

Command Syntax : FREQ <frequency><*ct*> <frequency> = 400 to 2810(Hz)

FREQ? <*ct*>

These commands select or read the transmitted frequency when the 4948A is in the transmit/receive tone mode. You can only change the frequency when the 4948A is STOPPED.

The enquiry command FREQ? will cause the 4948A to return the command mnemonic and the currently selected frequency.

Response : FREQ <frequency><*rt*>

e.g. If the current frequency is 1800Hz, the FREQ? command returns FREQ 1800.

GNHT .. .. Gain Hit Threshold

Command Syntax : GNHT <selector><*ct*> <selector> = 1 to 4

GNHT?<*ct*>

These commands set or read the gain hit threshold. You cannot change the threshold if the 4948A is logging.

The GNHT command sets the threshold value above which a gain hit will be counted, subject to the qualifications in the measurement specification.

<selector>	Threshold Value
1	1 dB
2	2 dB
3	3 dB
4	6 dB

The enquiry command GNHT? will cause the 4948A to return the command mnemonic and the current threshold setting.

Response : GNHT <selector><*rt*>

e.g. If the gain hit threshold is currently set at 6dB, the GNHT? command returns GNHT 4.

ID? .. .. Identification Enquiry

Command Syntax : ID?<*ct*>

This command causes the 4948A to output its identification string.

Response : HP4948A<*rt*>

IMNT .. .. Impulse Noise Threshold

Command Syntax : IMNT <selector><*ct*> <selector> = 1 to 4

IMNT?<*ct*>

These commands set or read the impulse noise threshold. You cannot change the threshold if the 4948A is logging.

The IMNT command sets the threshold value above which impulse noise will be counted, subject to the qualifications in the measurement specification.

<selector>	Threshold Value
1	-18 dB
2	-12 dB
3	-6 dB
4	0 dB

The enquiry command IMNT? will cause the 4948A to return the command mnemonic and the current threshold setting.

Response : IMNT <selector><*rt*>

e.g. If the impulse noise threshold is currently set at -12dB, the IMNT? command returns IMNT 2.

INPUT .. .. Receiver Input

Command Syntax : INPUT <selector><*ct*> <selector> = 1 or 2

INPUT?<*ct*>

These commands select or read the receiver input port. You can only change port selection when the 4948A is STOPPED.

<selector>	Input
1	RX1
2	RX2

The enquiry command INPUT? will cause the 4948A to return the command mnemonic and the currently selected port.

Response : INPUT <selector><*rt*>

e.g. If the receiver port currently selected is RX2, the INPUT? command returns INPUT 2.

KEY? .. .. Front Panel Key Enquiry

Command Syntax : KEY?<*ct*>

Response : <key code><*rt*>

<key code>	Key
0	NO KEY
1	INDEX/PAGE
2	PAGE NEXT
3	PAGE PREV
4	CURSOR POSITION PREV
5	CURSOR POSITION NEXT
6	CHANGE NEXT
7	CHANGE PREV
8	START/STOP
9	LOCAL

NOTE

There is no code for the LIGHT key.

If the 4948A is operating remotely and the front panel is active (DSP command not in use) the only key that is detected when pressed is the LOCAL key. The LOCAL key also sets the FPS (Front Panel Service Request) bit in the primary status byte.

When the DSP command is used the front panel is suspended (except for the LIGHT key). In this mode, the KEY command can detect any front panel key that is pressed. The FPS in the primary status byte will also be set. If no suitable key has been pressed before the KEY? command is issued then, a value of 0 is returned.

When the 4948A front panel is suspended due to a DSP command, you can return the 4948A to the normal display by issuing the RSTP command. It does not return it to the local state.

LCL .. .. Local *(RS-232-C only)*

Command Syntax : LCL<*ct*>

This command returns the 4948A to the local state, clears local lockout and enables you to operate the 4948A via the front panel.

LEVEL .. .. Transmit Level

Command Syntax : LEVEL <level><*ct*> <level> = -40 to 0 (dBm)

LEVEL?<*ct*>

These commands select or read the transmitted level when the 4948A is operating in the transmit/receive tone or tx simulated modem signal operating mode. You can only change the level when the 4948A is STOPPED.

The enquiry command LEVEL? will cause the 4948A to return the command mnemonic and the currently selected level value.

Response : LEVEL <level><*rt*>

e.g. If the current level is -13dBm, the LEVEL? command returns LEVEL -13.

LGFR .. .. Log From Start/Time Control

Command Syntax : LGFR <selector>,<hours>,<minutes><*ct*> <selector> = 1 or 2
<hours> = 0 to 23
<minutes> = 0 to 59

LGFR?<*ct*>

These commands set or read the time when logging is to start. You can only set the start time when the 4948A is STOPPED and in either the transmit/receive tone or receive modem signal mode.

If <selector>=1 then <hours> and <minutes> are ignored but dummy values must be supplied. Data logging will commence once the 4948A is running and has found one modem type.

If <selector> = 2 then <hours> and <minutes> parameters must be supplied to define the start time (24 hour clock). However, if the 4948A has not started or not found the modem type by this time then logging will not commence until the time occurs again up to 24 hours later.

<selector>	Log From
1	start
2	time

The enquiry command LGFR? returns the command mnemonic and the current "log from" configuration.

Response : LGFR <selector>,<hours>,<minutes><*rt*>

e.g. If the log is to start at 9.00pm, the LGFR? command returns LGFR 2,21,0

LOG .. .. Log Type

Command Syntax : LOG <selector><*ct*> <selector> = 1 to 3

LOG?<*ct*>

These commands select or read the log type. You cannot change the LOG TYPE if you are already logging or are in the tx simulated modem signal operating mode.

<selector>	Log Type
1	off
2	periods
3	events

The enquiry command LOG? will cause the 4948A to return the command mnemonic and the current log type.

Response : LOG <selector><*rt*>

e.g. If the log type is set at periods, the LOG? command returns LOG 2.

LOGE .. .. Logged Events

Command Syntax : `LOGE <year>,<month>,<day of month>,<hours>,<minutes>,<seconds>,<maximum><rt>`

<year> = 1901 to 2099
<month> = 1 to 12
<day of month> = 1 to 28, 29, 30 or 31
<hours> = 0 to 23
<minutes> = 0 to 69
<seconds> = 0 to 59
<maximum> = 1 to 1000

This command reads a maximum of N events, starting from the first event on or after the specified time, when the 4948A is logging in the `receive modem signal` or `transmit/receive tone` modes. N can be any number up to 1000.

The parameter <maximum> specifies the largest number of past events that the controller is able to accept. This value is an upper limit: the 4948A may or may not be able to supply that many.

Response : `<request status><rt>`
`<number of events><rt> <data block>*`

*A <data block> is returned for each event ie, if <number of events> = 3 then 3 <data block>s are returned. The oldest event is returned first.

The first response, <request status>, indicates the status of the requested time with respect to the log contents.

If the requested time is earlier than the time of the earliest event in the log, then the command is interpreted as a request for <maximum> events starting with the earliest available.

If the requested time is "in" the log, then the command is interpreted normally as a request for <maximum> events starting from the first event on or after the specified time.

In either case, the second response, <number of events>, indicates the number of events for which the 4948A is about to return data blocks. If fewer than the specified maximum are available, then this value will be the number available. If the number of events available is equal to or greater than the specified maximum, then the volume of data is restricted to the maximum and <number of events> echos the maximum specified. It is worth emphasising that if <number of events> is 0 then no data blocks are returned.

If the requested time is later than the time of the most recent event in the log, then the command is a request for non-existent events, <number of events> will be 0, and no data blocks will be returned.

Finally, <request status> may simply indicate that there are no logged results, in which case <number of events> will be 0, and no data blocks will be returned.

<request status> = 1 to 4

Code	Status
1	No logged results
2	Requested time earlier than earliest event in log
3	Requested time in log
4	Requested time later than latest event in log

<number of events> = 0 to 1000

<data block>: <year>,<month>,<day of month>,
<hours>,<minutes>,<seconds><*rt*>
<power status><*rt*>
<receiver state><*rt*>
<signal level alarm>,<qb>,<signal to noise ratio alarm>,<qb>, <carrier frequency alarm>,<qb>,
<phase modulation alarm>,<qb>,<phase jitter alarm>,<qb>,
<amplitude modulation alarm>,<qb>,<amplitude jitter>,<qb><*rt*>
<phase hits>,<qb>,<gain hits>,<qb>,
<impulse noise>,<qb>,<drop outs>,<qb><*rt*>
<retrains>,<qb><*rt*>
<data rate changes>,<qb><*rt*>

<power status> = 1 to 3

Code	Status
1	Power ok
2	Power failure
3	Logging resumed

<receiver state> = 1 to 21 (see RCVS)

<signal level alarm>
<signal to noise ratio alarm>
<carrier frequency alarm>
<phase modulation alarm>
<phase jitter alarm>
<amplitude modulation alarm>
<amplitude jitter alarm>
} = 1 to 3

Code	Type of Alarm
1	No alarm
2	Lower threshold alarm
3	Upper threshold alarm

<phase hits>
<gain hits>
<impulse noise>
<dropouts>
<retrains>
<data rate changes>
} = 0 or 1

<qb> = (See Page 4-14)

LOGED .. .. Logged Events Delta

Command Syntax : LOGED<*cf*>

This command reads all the events logged since the last LOGED command was issued or since the 4948A was started, or since the last LOGE command, if this is the first use of LOGED. Use LOGED when the 4948A is logging and in the receive modem signal or transmit/receive tone modes. LOGED allows logged data to be extracted regularly without loss or duplication.

The response to the LOGED command is given below.

Response : <number of events><*rf*><data block>*

<number of events> = 0 to 1000
<data block> = see LOGE command on Page 4-67.

*A <data block> is returned for each event ie, if the <number of events> returned = 3 then 3 <data block>s are returned. If <number of events> = 0 then no <data block>s are returned. The oldest event is returned first.

LOGP .. .. Logged Periods

Command Syntax : LOGP <year>,<month>,<day of month>,<hours>,
<minutes>,<seconds>,<maximum><*rf*>

<year> = 1901 to 2099
<month> = 1 to 12
<day of month> = 1 to 28, 29, 30 or 31
<hours> = 0 to 23
<minutes> = 0 to 59
<seconds> = 0 to 59
<maximum> = 1 to 200

This command reads a maximum of N periods, starting from the first period or from a specified time, when the 4948A is logging and in the receive modem signal or transmit/receive tone modes. N can be any number up to 200.

The parameter <maximum> specifies the largest number of past periods that the controller is able to accept. This value is an upper limit, the 4948A may or may not be able to supply that many.

Response : `<request status><rl>`
`<number of periods><rl><data block>*`

* A <data block> is returned for each period ie, if <number of periods> = 3 then 3 <data block>s are returned. The oldest period is returned first.

The first response, <request status>, indicates the status of the requested time with respect to the log contents.

If the requested time is earlier than the start time of the earliest period in the log, then the command is interpreted as a request for <maximum> periods starting with the earliest available.

If the requested time is "in" the log, then the command is interpreted normally as a request for <maximum> periods starting from the first period on or after the specified time.

In either case, the second response, <number of periods>, indicates the number of periods for which the 4948A is about to return data blocks. If fewer than the specified maximum are available, then this value will be the number available. If the number of periods available is equal to or greater than the specified maximum, then the volume of data is restricted to the maximum and <number of periods> echos the maximum specified. It is worth emphasising that if <number of periods> is 0 then no data blocks are returned.

If the requested time is later than the time of the most recent period in the log, then the command is a request for non-existent periods, <number of periods> will be 0, and no data blocks will be returned.

Finally, <request status> may simply indicate that there are no logged results, in which case <number of periods> will be 0, and no data blocks will be returned.

The logging percentage response in the <data block> indicates the fraction of the nominal period length for which results averaging took place. This is affected by e.g. time spent training or power failures.

<request status> = 1 to 4

Code	Status
1	No logged results
2	Requested time earlier than earliest period in log
3	Requested time in log
4	Requested time later than latest period in log

<number of periods> = 0 to 200

<data block> = <year>,<month>,<day of month>,
<hours>,<minutes>,<seconds><*rt*>
<logging percentage><*rt*>
<logged status><*rt*>
<signal level av>,<qb>,<signal level max>,<qb>,<signal level min>,<qb><*rt*>
<s/n ratio av>,<qb>,<s/n ratio max>,<qb>,<s/n ratio min>,<qb><*rt*>
<carr. freq av>,<qb>,<carr. freq max>,<qb>,<carr. freq min>,<qb><*rt*>
<phase mod av>,<qb>,<phase mod max>,<qb>,<phase mod min>,<qb><*rt*>
<phase jitter av>,<qb>,<phase jitter max>,<qb>,<phase jitter min>,<qb><*rt*>
<amp mod av>,<qb>,<amp mod max>,<qb>,<amp mod min>,<qb><*rt*>
<amp jitter av>,<qb>,<amp jitter max>,<qb>,<amp jitter min>,<qb><*rt*>
<phase hits>,<qb>,<gain hits>,<qb>,
<impulse noise>,<qb>,<dropouts>,<qb><*rt*>
<instrument retrains>,<qb><*rt*>
<data rate changes>,<qb><*rt*>

<logging percentage> = 0 to 100 (%)

<logged status> = see "weight" in table below

Bit	Weight	Meaning of bit if set
15	32768	-
14	16384	Fallback
13	8192	Non random data
12	4096	Timing offset
11	2048	Carrier offset
10	1024	-
9	512	Intermittent signal
8	256	Wrong signal/excess impairments
7	128	No in-band signal
6	64	Signal too high
5	32	Signal too low
4	16	Training
3	8	-
2	4	Time discontinuity in log
1	2	Stop
0	1	Power failure

`Time discontinuity in log` is set if a log power failure occurs so that one or more complete periods are not present in the log. It is set in the first period after the gap.

`Stop` is set if the `STOP` command is received from the front panel or by remote control so that the last period is shortened.

`Power failure` is set if power disappears or recovers during the period, or on issue of the device clear, selective device clear and `CLR` command. Other bits are set, if a particular condition occurs during a period. The meaning of the conditions is given on Page 2-14.

<signal level av>,<signal level max>,<signal level min> = -51.0 to 1.0 (dBm)
<s/n ratio av>,<s/n ratio max>,<s/n ratio min> = 13 to 45 (dB)*
<carr. freq av>,<carr. freq max>,<carr. freq min>, = 395.0 to 2815.0 (Hz)*
<phase mod av>,<phase mod max>,<phase mod min> = 0.0 to 35.0 (deg pk-pk)
<phase jitter av>,<phase jitter max>,<phase jitter min> = 0.0 to 35.0 (deg pk-pk)
<amp mod av>,<amp mod max>,<amp mod min> = 0.0 to 25.0 (% pk)
<amp jitter av>,<amp jitter max>,<amp jitter min> = 0.0 to 25.0 (% pk)

<phase hits> = 0 to 9999
<gain hits> = 0 to 9999
<impulse noise> = 0 to 9999
<dropouts> = 0 to 9999
<instrument retrains> = 0 to 9999
<data rate changes> = 0 to 9999

<qb> = see Page 4-14

*As for other measurements, a value of zero is returned if the results is not applicable or not yet available (see Page 4-14).

LOGPD .. .. Logged Periods Delta

Command Syntax : LOGPD<*ct*>

This command reads all the period data logged since the last LOGPD command was issued or since the 4948A was started, or since the last LOGP command, if this is the first use of LOGPD. Use LOGPD when the 4948A is logging and in the `receive modem signal` or `transmit/receive tone` modes. LOGPD allows logged data to be extracted regularly without loss or duplication.

The response to the LOGPD command is given below.

Response : <number of periods><*rt*><data block>*

<number of periods> = 0 to 200
<data block> = see LOGP command on Page 4-70.

*A <data block> is returned for each period ie, if the <number of period>s = 3 then 3<data block>s are returned. The oldest is returned first.

LOGS .. .. Logging State

Command Syntax : LOGS<*cr*>

This command reads the current state of the logging process if the 4948A is either in the `receive modem signal` or `transmit/receive tone` operating modes

Response : `<state>`<*rt*> <state> = 1 to 5

<state>	Logging State	Description
1	off	The logging process is not running. This may be because logging is not selected, or because the 4948A has not been started.
2	imminent	The 4948A has been started with logging selected but has not reached the auto-search/waiting/active decision point. This is a transitory state.
3	autosearch	The 4948A has been started with logging selected but is currently autosearching for the modem type. Once the modem has been "found", the logging process will proceed to the waiting or active state.
4	waiting	The 4948A has been started with "log from time" selected, and the logging process is now waiting for the specified time to arrive before becoming active.
5	active	The 4948A has started logging results.

LSTPT .. .. .. Log Stop Time

Command Syntax : LSTPT<*ct*>

This command reads the time when data logging stopped. The first value returned is an availability flag: if this is 0 then there is no log stop time recorded and none is returned. If the flag = 1 then the log stop time is returned.

The response to LSTPT is given below.

Response : <available><*rt*>
<year>,<month>,<day of month>,
<hours>,<minutes>,
<seconds><*rt*>

<available> = 0 to 1
<year> = 1901 to 2099
<month> = 1 to 12
<day of month> = 1 to 28, 29, 30 or 31
<hours> = 0 to 23
<minutes> = 0 to 59
<seconds> = 0 to 59

LSTRT .. .. Log Start Time

Command Syntax : LSTRT<*ct*>

This command reads the time when data logging was started. The first value returned is an availability flag: if this is 0 then there is no log start time recorded and none is returned. If the flag = 1 then the log start time is returned.

The response to LSTRT is given below.

Response : <availability><*rt*>
<year>,<month>,<day of month>,
<hours>,<minutes>,
<seconds><*rt*>

<available> = 0 or 1
<year> = 1901 to 2099
<month> = 1 to 12
<day of month> = 1 to 28, 29, 30 or 31
<hours> = 0 to 23
<minutes> = 0 to 59
<seconds> = 0 to 59

MDMS .. .. Modem Selection Method

Command Syntax : MDMS <selector><*ct*> <selector> = 1 or 2

MDMS?<*ct*>

These commands set or read the modem selection method. You can only set the modem selection method if the 4948A is STOPPED and in the receive modem signal mode. If manual selection is programmed the modem type must be set using RCVM.

<selection>	Method
1	manual
2	automatic

The enquiry command MDMS? will cause the 4948A to return the command mnemonic and the currently selected modem selection method.

Response : MDMS <selector><*rt*>

e.g. If the modem selection method is set to automatic, the MDMS? command returns MDMS 2.

MSC? .. .. Miscellaneous Events Enquiry

Command Syntax : MSC?<*ct*>

The command reads the miscellaneous events register. This 8-bit register records the occurrence of events related to the measurement process. When bits are set in this 8-bit register, they remain set until read by a controller even if they no longer reflect the current status of an event. To read the contents of the register issue the MSC? command.

The response to the MSC? command is shown below.

Response : <register><*rt*> <register> = see table below

Bit	<register>	Meaning of bit if set
7	128	New data spectrum result available
6	64	All measurement available
5	32	Logging period complete
4	16	-
3	8	-
2	4	-
1	2	-
0	1	-

`New data spectrum` will be set every time a new data spectrum is computed and reset only when this register is read. This bit can be used to cause a service request.

`All measurements available` will be set when the instrument enters the all measurements available receiver state, and reset only when this register is read. This bit can be used to cause a service request.

`Logging period complete` will be set when a logging period has been completed and reset only when this register is read. It can be used to cause a service request (see also MSCE).

MSCC? .. .. Miscellaneous Conditions Enquiry

Command Syntax : MSCC?<*ct*>

This command reads the miscellaneous conditions register. This 8-bit register holds the current state of conditions related to the measurement process.

The response to the MSCC? command is given below:

Response : <register><*rt*> <register> = see the table on Page 4-76.

Bit	<register>	Meaning of bit if set
7	128	New data spectrum result available
6	64	All measurements available
5	32	-
4	16	-
3	8	-
2	4	-
1	2	-
0	1	-

New data spectrum will be set every time a new data spectrum is computed and reset if and when the results are read by the controller. This bit allows a controller to monitor the availability of data spectrum results without actually having to read them (see **DTSP** command). The equivalent bit in the miscellaneous events register can be used to cause a service request.

All measurements available will be set when the instrument enters the all measurements available receiver state, and reset when it leaves that state. This bit is primarily included so that the equivalent bit in the miscellaneous events register can be used to cause a service request, but it also provides a method of checking that all measurements are available without using state numbers.

MSCE .. .. Miscellaneous Events Enable

Command Syntax : **MSCE<mask>**<*ct*> <mask> = see **MSC?** for bit assignment (see Page 4-75).

MSCE?<*ct*>

These commands set and read the miscellaneous events enable register.

The programmed mask enables/disables selected events from affecting the **MSC** summary bit in the primary status byte. It does not prevent the event from registering in the miscellaneous event register.

If the mask bit is 0 then the corresponding bit in the miscellaneous event register will have no effect on the summary bit in the primary status byte.

If the mask bit is 1 then if the corresponding bit in the event register is set, the summary bit in the primary status byte will also be set. If the bit in the event register is reset then the summary bit in the primary status byte will be reset unless there are other unmasked events causing it to remain set.

The enquiry **MSCE?** returns the following:

Response : **MSCE <mask>**<*rt*>

<mask> = see **MSC?**(Page 4-75)

OPRM .. .. Operating Mode

Command Syntax : OPRM <selector><*cr*> <selector> = 1 to 3

OPRM?<*cr*>

These commands select or read the operating mode of the 4948A. You can only change the operating mode if the 4948A is STOPPED.

<selector>	Operating Mode
1	Receive modem signal
2	Transmit/receive tone
3	Transmit simulated modem signal

NOTE

There are two other operating modes (Service and Self-Test) which are available but not under normal operating conditions. For more information see Service Manual.

The enquiry command OPRM? will cause the 4948A to return the command mnemonic and the current operating mode.

Response : OPRM <selector><*rt*>

e.g. If the operating mode is set to receive modem signal, the OPRM? command returns OPRM 1.

OPT? .. .. Option Query

Command Syntax : OPT?<*cr*>

This command reads the (processor detectable) options in the 4948A. Since there are none, this command always returns 0.

Response : 0<*rt*>

PHHT .. .. Phase Hits Threshold

Command Syntax : PHHT <selector><ct> <selector> = 1 to 3

PHHT?<ct>

These commands set or read the phase hits threshold. You cannot change the threshold if the 4948A is logging or in the tx simulated modem signal operating mode.

The PHHT command sets the threshold above which a phase hit will be counted, subject to the qualifications detailed in the measurement specification.

<selector>	Threshold Value
1	10 degrees
2	15 degrees
3	20 degrees

The enquiry command PHHT? will cause the 4948A to return the command mnemonic and the current threshold.

Response : PHHT <selector><rt>

e.g. If the phase hit threshold is set at 15 degrees, the PHHT? command returns PHHT 2.

PHJT .. .. Phase Jitter Threshold

Command Syntax : PHJT <threshold><ct> <threshold> = 4 to 30 (deg pk-pk)

PHJT?<ct>

These commands set or read the phase jitter threshold. You cannot change the threshold if the 4948A is logging.

If event logging is active and the receiver has reached the all measurements available state then, subject to hysteresis , a positive transition through this threshold will cause a phase jitter alarm event to be recorded.

The enquiry command PHJT? returns the command mnemonic and the current threshold.

Response : PHJT <threshold><rt>

e.g. If the phase jitter threshold is set at 10 degrees pk-pk, the PHJT? command returns PHJT 10.

PHMT .. .. Phase Modulation Threshold

Command Syntax : PMHT <threshold><*ct*> <threshold> = 4 to 30 (deg pk-pk)

PHMT?<*ct*>

These commands set or read the phase modulation threshold. You cannot change the threshold if the 4948A is **logging** or in the **tx simulated modem signal** operating mode.

If event logging is active and the receiver has reached the **all measurements available** state then, subject to hysteresis, a positive transition through this threshold will cause a phase modulation alarm event to be recorded.

The enquiry command PHMT? returns the command mnemonic and the current threshold.

Response : PHMT <threshold><*rt*>

e.g. If the phase modulation is set to 10 degrees pk-pk, the PHMT? command returns PHMT 10.

PON .. .. Power Fail Recovery - RQS and Event Mask Control

Command Syntax : PON <control><*ct*> <control> = 0 or 1

PON?<*ct*>

The PON command enables/disables the preservation of the service request and event masks at power-on and after a "device clear", "selective device clear", CLR or RST command.

The service request mask is programmed using the RQS command. The event masks are programmed using the MSCE, SSAE and TRAE commands.

When 1 is selected, the service request and event enable masks which are programmed prior to the power-down or device clear will be used unaltered. If 0 is selected, then the RQS masks if initialized to 32 (ERR bit enabled), and clears the MSCE, SSAE and TRAE masks to zero.

The enquiry command PON? reads the service/event mask preservation flag and returns the command menmonic and the current flag.

Response : PON <control><*rt*>

PRDL .. .. Periods Logged

Command Syntax : PRDL<*ct*>

Reads the total number of periods logged.

Response : <period count><*rt*> <period count> = 0 to 200

RCVI .. .. Receiver Impedance

Command Syntax : RCVI <selector><*ct*> <selector> = 1 or 2

RCVI? <*ct*>

Whether the receiver is terminated or bridged, it must be set for the correct impedance. These commands set or read the receiver setting. You can only change the receiver setting if the 4948A is STOPPED.

<selector>	Setting
1	600Ω
2	900Ω

The enquiry command RCVI? returns the command mnemonic and the current setting

Response : RCVI <selector><*rt*>

e.g. If the receiver is set for 900Ω, the RCVI? command returns RCVI 2.

See also RCVT.

RCVM .. .. Receive Modem

Command Syntax : RCVM <selector><*ct*> <selector> = 1 to 6

RCVM?<*ct*>

This setting is only used by the 4948A if modem selection is set to manual (see MDMS).

These commands select or read the receive modem type. You can only select the receive modem type when the 4948A is STOPPED and in the **receive modem signal** operating mode.

<Selector>	Modem Type
1	201B/C, V.26 or V.27 fallback type
2	208, 2048 or V.27 type
3	V.29 type
4	2096 type
5	209 type
6	V.29 (1800 Hz) type

The enquiry command RCVM? returns the command mnemonic and the current receive modem type.

Response : RCVM <selector><*rt*>

e.g. If the receive modem type is 209 type, the RCVM? command returns RCVM 5.

RCVS .. .. Receiver State

Command Syntax : RCVS<*cf*>

If the 4948A is in the receive modem signal or transmit/receive tone mode the RCVS command reads the state of the receiver and returns the following:

Response : <state><*rf*> <state> = 1 to 21

<state>	Receiver State
1	receiver inactive
2	autoranging
3	autoranging, signal too low
4	autoranging, signal too high
5	autoranged, no in-band signal
6	receiver training state 1
7	wrong signal type/excessive impairments
8	intermittent signal
9	receiver training state 2
10	all measurements available
11	carrier offset
12	timing offset
13	timing and carrier offset
14	non random data
15	non random data, carrier offset
16	non random data, timing offset
17	non random data, timing and carrier offset
18	fallback
19	fallback, carrier offset
20	fallback, timing offset
21	fallback, timing and carrier offset

The meaning of these states is explained on Page 2-14.

RCVT .. .. Receive Termination

Command Syntax : RCVT <selector><*ct*> <selector> = 1 or 2

RCVT?<*ct*>

These commands set or read the receive termination. You can only change the receive termination if the 4948A is STOPPED. This command does not act instantly - even if **terminated** is selected, the 4948A will only terminate the line after the START command or keystroke, and will revert to bridging when it stops.

<selector>	Termination
1	bridged
2	terminated

The enquiry command RCVT? returns the command mnemonic and the current setting.

Response : RCVT <selector><*rt*>

e.g. If the current termination is bridged, the RCVT? command returns RCVT 1.

See also RCVI.

REV? .. .. Revision Enquiry

Command Syntax : REV?<*ct*>

This command reads the 4948A's instrument firmware revision date, and the revision date of the latest applicable Codes and Formats document to which the 4948A was designed in <yyww> format; where yy = year from 1960 and ww = week number.

Response : <firmware rev>,<codes and format rev><*rt*>

RMSS .. .. Receive Modem State Enquiry

Command Syntax : RMSS<*rt*>

This command reads the state of the manual/automatic modem search.

The value returned indicates which modem type is currently being tried or, if training has advanced sufficiently, which modem type has been found.

The only difference between **manual** and **automatic** modem selection is that in automatic mode the instrument may sequence though the trying messages whereas in manual mode, the **trying** message will simply echo the state of the RCVM selector.

Response : <state><*rt*> <state> = 1 to 15

<state>	Manual/autosearch status
1	receiver inactive
2	trying 201B/C, V.26, V.27 fallback
3	trying 208, 2048, V.27 type
4	trying V.29 type
5	trying 2096 type
6	trying 209 type
7	trying V.29 (1800 Hz) type
8	found 201B/C or V.26 scheme B
9	found V.26 scheme A or V.27 fallback
10	found 208 or 2048 type
11	found V.27 type
12	found V.29 type
13	found 2096 type
14	found 209 type
15	found V.29 (1800 Hz) type

RMT .. .. Remote *(RS-232-C only)*

Command Syntax : RMT<*ct*>

The command causes the 4948A to go into the REMOTE state **with local lockout on.** This enables the 4948A to accept commands from the interface which modify its configuration and disables commands from the front panel which would modify its configuration. This command is only available via the RS-232-C control interface.

RQS .. .. Request Service Enable

Command Syntax : RQS <mask><*ct*> <mask> = 0 to 255
(see table below)

RQS?<*ct*>

These commands set or read the service request enable mask register. The RQS bit itself has no associated mask bit.

Bit	<mask>	Meaning of bit if set
7	128	Miscellaneous events summary
6	64	-
5	32	Error bit
4	16	Ready bit
3	8	Power on bit
2	4	Front panel service request
1	2	Steady state alarms summary
0	1	Transient events summary

The enquiry command RQS? returns the mnemonic and the current mask.

Response : RQS <mask><*rt*> <mask> = see table above

RST .. .. Reset Instrument

Command Syntax : RST<*ct*>

This command causes the 4948A to set the measurement and display related settings to their fixed default values - see table on Page 4-86. Settings related to the remote interface configuration and printer output are not remotely configurable and are not reset. The error register, primary status byte, MSCE, SSAE and TRAE event registers are also cleared, while the RQS enable register is initialized to 32 (ERR bit enabled). The PON flag is set following this command.

Parameter	Default Setting
Start/Stop	**stopped**
Operating Mode	**receive modem signal**
Modem Selection	**manual**
Receive Modem	**201B/C type**
Transmitter	on
Level	-13dBm
Frequency	1004 Hz
Transmit Modem	201B/C type
Test Group	measurement hardware
Signal Processor Test	complete test
Analog Circuits Test	complete test
External Interfaces Test	TX to RX 1
Repeat	off
Number Of Faults	0
Service Group	firmware revision
Signal Processor Service	control register write
Analog Circuits Service	analog calibration
Receiver Input	**RX 1**
Receiver Impedance	600Ω
Receiver Termination	**bridged**
Transmit Impedance	600Ω
Displayed Curr/Logged Result	**status**
Displayed Spectrum Point	**center frequency**
Logged Status Sub-select	**miscellaneous**
Logging Setup/Summary	**setup**
Logging Control	**logging off**
Log From	start
Log From (Time)	00:00
Period Duration	5 minutes
Log Contents	no logged results
Thresholds	**transients**
Limit Alarm Threshold	**upper signal level**
Gain Hit Threshold	**3 dB**
Phase Hit Threshold	**10 degrees**
Impulse Noise Threshold	**2 dB**
Upper Signal Level Threshold	**-1 dB**
Lower Signal Level Threshold	**-49 dB**
Signal/Noise Ratio Threshold	**18 dB**
Upper Carrier Freq Threshold	**2809Hz**
Lower Carrier Freq Threshold	**401 Hz**
Phase Modulation Threshold	**30 degrees**
Phase Jitter Threshold	**30 degrees**
Amplitude Mod Threshold	**20 %**
Amplitude Jitter Threshold	**20 %**

Although all settings are listed, not all are simultaneously active - for example `transmitter on` is not relevant since the operating mode is `receive modem signal`. Settings listed in **bold** are the active ones in the default state.

RSTP .. .. Restore Page

Command Syntax : RSTP<*ct*>

This command causes the 4948A to re-display the page it was displaying prior to messages being written onto the display using the DSP command. This command also resets the response to the KEY? command to 0 (no key) and resets the FPS bit in the primary status byte.

NOTE

It is essential to restore the page after using the DSP command to resume normal front panel operation.

RSTT .. .. Reset Transients and Timer

Command Syntax : RSTT<*ct*>

This command allows the gain hit, phase hit, impulse noise and dropout counts to be reset in the same manner as the front panel reset field. This command also resets the associated transient timer. You can use RSTT when the 4948A is running and in the `receive modem signal` or `transmit/receive tone` mode and logging is off.

SER? .. .. Serial Number Query

Command Syntax : SER?<*ct*>

This command reads the 4948A's serial number. Since 4948A's are not programmed with individual serial numbers the response is the standard "dummy" serial number.

Response : `<serial number>`<*rt*> <serial number> = typical value is "2645U00000"

SGLLT .. .. Signal Level Lower Threshold

Command Syntax : `SGLLT <threshold><ct>` <threshold> = -49 to (upper threshold -1) (dBm).

`SGLLT?<ct>`

These commands set or read the signal level lower threshold. You cannot change the threshold value if the 4948A is **logging** or in the **tx simulated modem signal** mode.

If event logging is active and the receiver has reached the **all measurements available** state then, subject to hysteresis, a negative transition through this threshold will cause a signal level lower alarm event to be recorded.

The enquiry command SGLLT? returns the command mnemonic and the current threshold value.

SGLUT .. .. Signal Level Upper Threshold

Command Syntax : `SGLUT <threshold><ct>` <threshold> = lower threshold+1 to -1 (dBm)

`SGLUT?<ct>`

These commands set or read the signal level upper threshold. You cannot change the threshold value if the 4948A is **logging** or in the **tx simulated modem signal** operating mode.

If event logging is active and the receiver has reached the **all measurements available** state then, subject to hysteresis, a positive transition through this threshold will cause a signal level upper threshold alarm event to be recorded.

The enquiry command SGLUT? returns the command mnemonic and the current threshold value.

Response : `SGLUT <threshold><rt>`

SNRT .. .. Signal/Noise Ratio Threshold

Command Syntax : `SNRT <threshold><ct>` <threshold> = 18 to 38 (dB)

`SNRT?<ct>`

These commands set or read the signal/noise ratio threshold. You cannot change the threshold value if the 4948A is **logging** or in the **tx simulated modem signal** mode.

If event logging is active and the receiver has reached **all measurement available** state then, subject to hysteresis, a negative transition through this threshold will cause a signal/noise ratio alarm event to be recorded.

The enquiry command SNRT? returns the command mnemonic and the current threshold value.

Response : `SNRT <threshold><rt>`

SSA? .. .. Steady State Alarm Events Enquiry

Command Syntax : SSA?<*ct*>

This command reads the steady state alarm events register.

The register records the occurrence of threshold alarm events for all steady state measurements during event logging. The bits in this register once set remain set until the register is read by a controller, even if they no longer reflect the current status of an event.

Response : <register><*rt*> <register> = see table below

Bit	<register>	Meaning of bit if set
15	32768	-
14	16384	Upper Signal Level Alarm
13	8192	Lower Signal Level Alarm
12	4096	Signal/Noise Ratio Alarm
11	2048	Upper Carrier Frequency Alarm
10	1024	Lower Carrier Frequency Alarm
9	512	Phase Modulation Alarm
8	256	Phase Jitter Alarm
7	128	Amplitude Modulation Alarm
6	64	Amplitude Jitter Alarm
5	32	-
4	16	-
3	8	-
2	4	-
1	2	-
0	1	-

SSAE .. .. Steady State Alarm Events Enable

Command Syntax : SSAE <mask><*ct*> <mask> = see SSA? for bit assignment.

SSAE?<*ct*>

These commands set and read the steady state alarms events enable register.

The programmed mask enables/disables selected alarm events from affecting the SSA summary bit in the primary status byte. It does not prevent the alarm event from registering in the steady state alarm events register.

If the mask bit is 0 then the corresponding bit in the event register will have no effect on the summary bit in the primary status byte.

If the mask bit is 1, then if the corresponding bit in the event register is set, the summary bit in the primary status byte will also be set. If the bit in the event register is reset then the summary bit in the primary status byte will be reset unless there are other unmasked events causing it to remain set.

The enquiry command SSAE? returns the following response:

Response : SSAE <mask><*rt*> <mask> = see SSA? for bit assignment.

START .. .. Start Instrument

Command Syntax : START<*ct*>

When the 4948A is stopped, the START command cause it to run.

Where as a second START keystroke is sometimes needed from the front panel in response to protective prompt messages, the remote START command always works first time.

The enquiry command START? reads the start/stop state of the 4948A.

Response : 0 or 1<*rt*>

1 indicates that the 4948A is started, 0 indicates that it is stopped.

STB? .. .. Status Byte Enquiry

Command Syntax : STB?<*ct*>

This command reads the 4948A primary status byte. This byte is the same as the serial poll response byte.

This command is intended primarily for use with the RS-232-C interface where the serial poll function is not available, although it may be used via the HP-IB interface to poll instrument status without resorting to a full service request/serial poll structure. However, the STB? is an ASCII command which must be parsed and therefore should not be used to service an SRQ which may occur at any time; e.g. during the parsing of another command.

Response : <byte><*rt*> <byte> = see table on Page 4-43.

Bit	<byte>	Mnemonic	Meaning of bit if set
7	128	MSC	Miscellaneous events summary
6	64	RQS	This device requested service
5	32	ERR	Error bit
4	16	RDY	Ready bit
3	8	PON	Power on bit
2	4	FPS	Front panel service request
1	2	SSA	Steady state alarm events summary
0	1	TRA	Transient events summary

STOP .. .. Stop Instrument

Command Syntax : STOP<*ct*>

STOP?<*ct*>

When the 4948A is running the STOP command will stop it.

Where as a second STOP keystroke is sometimes needed from the front panel in response to protective prompt messages, the remote STOP command always works first time.

The enquiry command STOP? reads start/stop state of the 4948A.

Response : 0 or 1<*rt*> 1 indicates that the 4948A is stopped, 0 indicates that it is started.

TIME? .. .. Time Enquiry

Command Syntax : TIME?<*ct*>

This command reads the current 4948A time and date as a formatted 22 character string.

Response : <string><*rt*>

e.g. <string> = "17th Feb 1986 11:16:47"

TRA? .. .. Transient Events Enquiry

Command Syntax : TRA?<*ct*>

This command reads the transient events register.

This register records the occurrence of measured transients and other transient events, that is instrument retrains and data rate changes. The bits in this register once set remain set until the register is read by the controller, even if they no longer reflect the current status of an event.

Response : <register><*rt*> <register> = see table below

Bit	<register>	Meaning of bit if set
7	128	Phase hit(s)
6	64	Gain hit(s)
5	32	Impulse noise
4	16	Dropout(s)
3	8	-
2	4	-
1	2	Instrument retrains
0	1	Data rate changes

TRAE .. .. .. Transient Event Enable

Command Syntax : TRAE <mask><*ct*> <mask> = see table under TRA? command

TRAE?<*ct*>

These commands set or read the mask for the transient event register.

The programmed mask enables/disables selected alarms from affecting the TRA summary bit in the primary status byte. It does not prevent the transient from registering in the transient event register.

If the mask bit is 0 then the corresponding bit in the event register will have no effect on the summary bit in the primary status byte.

If the mask bit is 1 then if the corresponding bit in the event register is set, the summary bit in the primary status byte will also be set. If the bit in the event register is reset then the summary bit in the primary status byte will be reset unless there are other unmasked events causing it to remain set.

The enquiry command TRAE? returns the command mnemonic and the current mask.

Response : TRAE <mask><*rt*>

TRNI .. .. Transmit Impedance

Command Syntax : `TRNI <selector><ct>` <selector> = 1 or 2

`TRNI?<ct>`

These commands set or read the transmitter impedance. You can only change the impedance if the 4948A is STOPPED.

<selector>	Impedance
1	600Ω
2	900Ω

The enquiry command `TRNI?` returns the command mnemonic and the current impedance setting.

Response : `TRNI <selector><rt>`

e.g. If the current transmit impedance is 600Ω , the `TRNI?` command returns `TRNI 1`.

TRNM .. .. Transmit Modem

Command Syntax : `TRNM <selector><ct>` <selector> = 1 to 10

`TRNM?<ct>`

These commands set or read the transmit modem type. You can only select the modem type if the 4948A is STOPPED.

<selector>	Modem Type
1	201B/C type
2	V.26 scheme A type
3	V.26 scheme B type
4	208 type
5	2048 type
6	V.27 type
7	V.29 type
8	2096 type
9	209 type
10	V.29 (1800 Hz) type

The enquiry command TRNM? returns the command mnemonic and the current modem type.

Response : TRNM <selector><*rt*>

e.g. If the transmitted modem signal is 209 type, the TRNM? command returns TRNM 9.

TRNS .. .. Transmitter Enable Control

Command Syntax : TRNS <control><*ct*> <control> = 0 or 1

TRNS?<*ct*>

These commands set or read the transmitter enable control. You can set the transmitter enable control if the 4948A is **stopped**.

If <control> = 0 the transmitter is disabled.
If <control> = 1 the transmitter is enabled.

NOTE

This command only selects whether the transmitter will be enabled or disabled when transmit/receive tone is selected and STARTED. It CANNOT be used to turn the transmitter on or off while the 4948A is running.

The enquiry command TRNS? returns the command mnemonic and the <control> parameter.

Response : TRNS <control><*rt*>

General Information 5

Introduction

This manual contains information which allows the user to operate the Hewlett-Packard Model 4948A In-Service Transmission Impairment Measuring Set. A 4948A together with the accessories supplied and initial inspection information are shown on Page x.

On the title page of this manual is a Microfiche Part Number. This number can be used to order 4 X 6 inch microfilm transparencies of the manual.

Specification

Instrument specifications are listed on Page 5-3. These specifications are the performance standards or limits against which the instrument is tested.

Safety Consideration

This product is a Safety Class I instrument (it is provided with a protective earth terminal). The instrument and manual should be reviewed for safety markings and instructions before operation. Also read the Warning on Page ii.

Instruments Covered By Manual

Attached to the instrument is a serial number plate. This serial number is in the form XXXXUXXXXX. It is in two parts; the first four digits and the letter are the serial prefix and the last five are the suffix. The prefix is the same for all identical instruments, it changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. The unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual for this new instrument is accompanied by a Manual Changes supplement. This supplement contains "change information" that explains how to adapt the manual to the new instrument.

In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with the manual print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard. For information concerning a serial number prefix that is not listed on the page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

Equipment Available

A printer/plotter and external controller can be used with this instrument. A typical example of each is listed here:

Model 310 (HP98580A)..... Controller
HP2225A (HP-IB)..... ThinkJet Printer
HP2225D (RS-232-C) ..... ThinkJet Printer

Options Available

The connector and rack mount options available with the 4948A are listed in the table below.

	Front Panel Connectors		Rear Panel Connectors		
OPTION	WECO 310 & BANTAM	SIEMENS	WECO 310 & BANTAM	SIEMENS	RACK MOUNT
STD	✓				
001	✓				✓
002			✓		✓
003		✓			
004		✓			✓
005				✓	✓

Option W30

3-year Extended Hardware support. Provides 2 additional years of return-to-HP hardware service support (for 2nd and 3rd years).

Specifications

Except where otherwise indicated, the following parameters are warranted performance specifications. Parameters described as "typical" or "nominal" are supplemental characteristics which provide a useful indication of typical, but non-warranted, performance characteristics.

1. GENERAL

Dimensions		
Stand-alone versions	:	163 mm. * 426 mm. * 570 mm.
		6.4ins. * 17ins. * 23ins.
Rack-mount versions	:	133 mm. * 426 mm. * 512 mm.
		5.3ins. * 17ins. * 20ins.
Weight	:	14 Kg / 30 lb
Power Supply	:	100-120/200-240 VAC±10%, 48 to 66Hz
Power Consumption	:	<100 VA
Temperature (Operating)	:	0 deg.C to +50 deg.C
(Storage)	:	-20 deg.C to +70 deg.C
Electro-Magnetic	:	Complies with FTZ 1046/84 licensing requirements.
compatibility		Meets Measurement Receiver Law FTZ 526/79 and FTZ 527/79 limits.
		Meets VDE 871 level B and FCC class B limits.

2. INSTRUMENT INTERFACES INFORMATION

Test input/output interfaces

Transmitter [Tx]	:	Selectable 600/900 Ohm balanced.
Receiver [Rx1&Rx2]	:	Balanced, selectable 600/900 Ohm termination or high impedance bridge [Rx1 and Rx2 mutually exclusive].
Longitudinal balance (nominal)	:	>= 90dB from 50 to 120Hz falling 6dB/octave from 120Hz to 3000Hz
Return loss (nominal)	:	>= 30dB from 200 to 4000Hz; 600 & 900 ohms.
Maximum DC blocking	:	150 volts transverse.
Maximum ringing voltage	:	as per IEEE 743-1984 6.4.2
Lightning protection	:	to BT RC 6634

HP-IB Interface

HP-IB capability list	:	SH1,AH1,T5,TE0,L4,LE0,SR1,RL1,PP0,DC1,DT0,C0
HP-IB Modes	:	Addressable, for remote control.
(mutually exclusive)		Talk only, to drive 80-column printer.

X-Y Outputs

Output Signal	:	Rx vector constellation
Connectors	:	BNC type
Output impedance	:	100 Ohm nominal
Maximum output level	:	± 5V nominal

RS-232-C Remote Control Interface

RS-232-C connector [DTE configuration] : 25 way female D-type (ISO 2110-1980 pin assignment)

RS-232-C capability

- Bit rates : 300, 600, 1200, 1800, 2400
- Connections : Hardwired, dial-up, leased
- Modes : Asynchronous, half or full duplex
- Word length : 7 bits
- Parity : Odd, even, mark, space
- Stop Bits : one or two
- Handshake : None, XON/XOFF and ENQ/ACK

RS-232-C 80-column Printer Interface

RS-232-C connector [DCE configuration] : 25 way female D-type (ISO 2110-1980 pin assignment)

Table A - Modem signal type definitions

Search Order	Modem signal type	Data modulation	Baud rate (Hz)	Expected carrier freq. (Hz)	Bit rate (bits/sec)
1.	CCITT V26 A	4-PSK	1200	1800	2400
	CCITT V26 B AT & T 201 B/C	4-PSK [+45 db/baud]	1200	1800	2400
2.	CCITT V27	8-PSK	1600	1800	4800
	AT & T 208/2048	8-PSK [+22.5dg/baud]	1600	1800	4800
3.	CCITT V29	V29 QAM	2400	1700	9600
4.	AT & T 2096	4*4 QAM	2400	1800	9600
5.	AT & T 209	4*4 QAM	2400	1650	9600
6.	CCITT V29 (1800Hz)	V29 QAM	2400	1800	9600

Note: CCITT V29 (1800Hz) type refers to a modem signal with a modulation scheme as defined in CCITT V29 but with a carrier frequency of 1800Hz. AT & T is a trademark of the American Telephone & Telegraph Company.

3. TRANSMITTER SPECIFICATION

Tone

Frequency range	:	400 to 2810Hz
Frequency resolution	:	1Hz
Frequency accuracy	:	± 50 ppm plus ±0.2Hz
Level range	:	0 to - 40dBm
Level resolution	:	1.0dB
Level accuracy	:	± 0.5dB
Total distortion [harmonics and spurious]	:	< -50dB
Maximum output settling time from run START	:	1.5 secs nominal

Simulated modem signal

Data signal types	:	see Table A
Level range	:	0 to - 40dBm
Level resolution	:	1.0dB
Level accuracy	:	± 0.3dB
Signal to noise ratio	:	> 40dB as measured by 4948A
Maximum output settling time from run START	:	1.5 secs nominal

Intrinsic Attenuation & Delay Distortion of Simulated Modem Signal - see Table B

Table B - Attenuation and Delay Distortion Nominal Frequency Range

Modem Signal Type	min (line -16) Hz	reference (carrier) Hz	max (line +16) Hz
V29	500	1700	2900
V29 (1800), 2096	600	1800	3000
209	450	1650	2850
V27, 2048, 208	1000	1800	2600
V26, 201	1200	1800	2400

Note: Attenuation & Delay Distortion are specified (and measured) at 32 frequencies spaced across the signal band (at n * baud rate/32 for n = -16.....+16) with respect to the carrier frequency (n = 0).

Intrinsic Attenuation and Delay Distortion in Simulated Modem Signals
Nominal values with respect to Carrier frequency (line 0)

line		-16	-15	-14	-13	-12 to +7	+8	+9	+10	+11	+12	+13	+14	+15	+16
V29 V29(1800) 2096,209	dB	+2.7	+1.3	+0.5			0						+0.5	+1.3	+2.7
	us				+/-10			+15	+15	+20	+20	+25	+25	+30	+35	+35
V27 2048 208	dB	+2.3	+1.1	+0.4	+0.1		0					+0.1	+0.4	+1.1	+2.3
	us				+/-10						+20				
V26 201	dB	+1.8	+0.9	+0.4	+0.1		0					+0.1	+0.4	+0.9	+1.8
	us				+/-10										+20

4. MEASUREMENT SPECIFICATION

4.1 General Information

Nominal input	:	209 type	475-2930Hz
filter 3dB	:	2096 type	575-3030Hz
bandwidths	:	V29 type	475-2930Hz
for each	:	V29(1800Hz) type	575-3030Hz
signal type	:	V27/208/2048 types	975-2625Hz
	:	V26/201 types	1170-2430Hz
	:	tone	255-2945Hz

4.2 Operating Modes

4.2.1 transmit/ receive tone

When this mode is selected, the 4948A will transmit a single tone or present a quiet termination. The receiver will make measurements on a tone at a frequency independent of the transmitter.

4.2.2 receive modem signal

When this mode is selected, the 4948A will make measurements on a modem signal. The 4948A has been designed to operate with the modem signals shown in Table A. They can be selected manually or the 4948A can be set to automatically identify the modem type. In this case the receiver attempts to train on each modem type in turn, in the order shown in Table A, until the correct signal is identified. When receiving a modem signal, the transmitter cannot be operated, but is quiet terminated with an output impedance of 600 or 900 ohms as selected.

Fallback States in Received Modem Signals

V29 or V29(1800Hz) type modems may drop into one of 2 fallback states, fallback 1 having an 8 point QAM constellation and a 7200 bits/sec data rate, and fallback 2 having a 4 phase PSK constellation and a 4800 bits/sec data rate. 209 & 2096 type signals may drop into one fallback state having a 4 phase PSK constellation and a bit rate of 4800 bits/sec.

The occurrence of a fallback state is automatically detected and indicated to the user by the 4948A. Operation will then continue with a reduced measurement set (see Measurement set and spec. warranty). Changes of data rate are counted as described in 4.7.2.

4.3 Data Logging

Period Logging

Operation : Continuous logging of measurement data in selectable periods of 5, 15, 30 or 60 minutes.
Log capacity : A maximum of 200 periods preceding the current period.
Short period : When period logging is stopped, a log entry which includes a "short period" warning is created for the data gathered since the end of the previous full period.

Event Logging

Operation : Continuous logging of the real-time occurrence of significant events. A significant event is defined as a one second interval which includes any of the following:

a) an out-of-limit value in a steady-state measurement
b) a dropout
c) a hit
d) a noise impulse
e) an instrument retrain
f) a data rate change
g) a receiver state change
h) power failure
i) power recovery

Log capacity : A maximum of 1000 events preceding the current time.

Data Logging Protection

Loss of power in either data logging mode is logged and in the case of periodic results does not cause loss of data for the periods affected.

Changes in data signal type [other than those associated with fallback/full rate changes in 2400 baud data signals] whilst data logging will cause data logging to terminate.

Note: Results of steady state measurements are only logged when the receiver has fully trained. Transient measurements are logged as soon as they become available (see 4.4).

4.4 Measurement set and specification warranty

i. All measurements are available to full specification when receiver reaches "all measurements available". Performance is similar but not warranted for results appearing during training stages 1 to 2.

ii. Unless otherwise stated, all specifications are warranted for a single impairment condition and with a 4948A as signal source.

iii. For data signal types, unless otherwise stated, all specifications are warranted for carrier frequency offsets up to ±10Hz and are nominal for offsets greater than ±10Hz and less than ±16.5Hz.

iv. All specifications are warranted for a signal level in the range 0 to -50dBm.

Note: Although the instrument has been designed to train even on poor quality channels, under certain severe combinations of attenuation and/or delay distortion, the instrument may be unable to train.

Measurement Availability

Available when.....	Measurements	Signal type			
		V29,209, 2096 & V29 (1800Hz)	V26,201, V27,208 & 2048	tone	V26/201 non random data
training stage 1 complete	SIGNAL LEVEL	Y	Y	Y	Y
training stage 2 complete	CARRIER FREQUENCY	Y	Y	Y	Y
all measurements available	SIGNAL/NOISE RATIO	Y	Y	Y	Y
	PHASE MODULATION (20-300Hz).	Y	Y	Y	Y
	PHASE JITTER (4-20HZ)				
	AMPLITUDE MODULATION (20-300Hz)	Y	Y	Y	Y
	AMPLITUDE JITTER (4-20Hz)	Y	Y	Y	Y
	DATA SPECTRUM				
	a. ATTENUATION and	Y	Y		
	b. DELAY	Y	Y		
	DROP-OUTS	Y	Y	Y	Y
	PHASE HITS	Y	Y	Y	Y
	GAIN HITS	Y	Y	Y	Y
	IMPULSE NOISE	Y	Y	Y	Y
	INSTRUMENT RETRAINS	Y	Y	Y	Y
	DATA RATE CHANGES	Y			

Receiver training stage 1 normally completes in a few seconds.

Receiver training stage 2 should be completed within the times shown for each signal type.

tone : 40s
V26, 201 : 95s
V27, 208, 2048 : 70s
V29, 209, 2096, V29 (1800Hz) : 50s

4.5 Steady state measurement specification

Steady state measurements are suspended as necessary during transient disturbances.

4.5.1 Signal level

Range	:	0 to -50dBm
Resolution	:	0.1dB
Accuracy (modem signal)	:	± 0.4dB
Accuracy (tone)	:	±0.3dB [990-1030Hz and 1800Hz]
Flatness (tone)	:	± 0.2dB [600-2700Hz]
(with respect to 1800Hz)	:	± 0.3dB [500-2810Hz]
	:	± 0.4dB [400-2810Hz]
Additional loss in bridging mode	:	<0.15dB
Alarm threshold Hysteresis	:	1dB

Supplemental characteristics

Some loss in signal level occurs if there is a mismatch between the modem signal spectrum and the 4948 input filter. The signal level measurement is compensated for a typical case.

Signal level compensation factors.	:	+0.25dB for V29, V29(1800Hz), 209 and 2096 types
	:	+0.3dB for V27 and 208 types
	:	+0.4dB for V26 and 201 types

Note: Specifications apply for measurements on a modem signal generated by a 4948A. Additional inaccuracy of measurements on actual modem signals:

± 0.1dB nominal (no secondary channel)
± 0.5dB nominal (secondary channel present)

Detector type	:	mean square value of signal within receiver input filter bandwidth (see MEAS SPEC general info)
Nominal averaging time	:	0.85 sec V29, V29(1800Hz), 209, 2096 types and single tone
	:	1.28 sec V27, 208, 2048 types
	:	1.71 sec V26, 201 types

4.5.2 Carrier frequency

Range (modem signal)	:	±16Hz around the expected carrier frequency of the received modem signal
Range (tone)	:	400Hz to 2810Hz (in Tx/Rx tone mode)
Resolution	:	0.1Hz
Accuracy	:	± 0.2Hz
Alarm threshold hysteresis	:	1Hz

Supplemental characteristics

```
Additional error due  :  ± 0.2Hz nominal for 20 deg p-p 4-20Hz
  to low frequency       phase jitter
    phase jitter

Additional error due  :  ± 0.2Hz nominal per 100 ppm error in Tx
due to excess timing     data rate
frequency offset in
   Tx data rate
```

4.5.3 Signal to noise ratio

```
Range (modem signal)  :  22 to 40dB
               Note   :  18 to 35dB for V26 and 201 types
       Range (tone)   :  18 to 40dB for tone in range 990Hz to 2200Hz
         Resolution   :  0.1dB
           Accuracy   :  ± 1.3dB  [ <35dB ]
                      :  ± 1.8dB  [ >35dB ]
   Result scaled for compromise C-message or psophometric weighting
    Background noise  :  < -90dBm
          floor
     Alarm threshold  :  + 2.0dB
        hysteresis
```

Supplemental characteristics

```
     Sample averaging  :  5secs nominal V27/208/2048 types
           time        :  7 secs nominal others

 Computational noise   :  >45dB nominal
         floor
  (no impairments )

 Computational noise   :  >32dB nominal for 20 deg pk to pk phase jitter
   floor with ph jtr   :  >37dB nominal for 10 deg pk to pk phase jitter

 Computational noise   :  >32dB nominal for 20%  pk amplitude jitter
  floor with amp jtr   :  >35dB nominal for 10%  pk amplitude jitter

 Computational noise   :  >34dB nominal for band edge delay = 6ms
    floor with delay
       distortion

 Computational noise   :  >32dB nominal for 24dB slope across data band
   floor with atten.
       distortion
```

4.5.4 Phase modulation [20 to 300Hz]

Range (modem signal)	:	0 to 15 deg pk to pk
Range (tone)	:	0 to 30 deg pk to pk
		[for tone in range 990Hz to 2200Hz]
Resolution	:	0.1 deg
Accuracy (modem signal)	:	± 0.2 deg plus - 10 or +10% of reading
		[modulation in range 20 to 290Hz]

Note: Using V26 or 201 signal types, phase modulation of 200Hz ± 10Hz may cause an additional error of up to -5%.

Accuracy (tone)	:	±0.2 deg plus -10 or +5% of reading
Alarm threshold hysteresis	:	3.0 deg

Supplemental characteristics

Weighting filter	:	< 9% of 2Hz phase modulation measured
edge characteristic	:	< 27% of 5Hz phase modulation measured
(nominal)	:	< 70% of 10Hz phase modulation measured
	:	< 27% of 500Hz phase modulation measured
Effect of noise		
i. no jitter	:	20dB S/N ratio will cause 0.4 deg nominal phase modulation.
ii. with jitter	:	30dB S/N ratio will cause an additional error of 0.5, +1.5 degrees nominal.
	:	24dB S/N ratio will cause an additional error of -1.0, +2.0 degrees nominal.
Accuracy at 300Hz	:	± 0.2 deg plus -20 or + 5% of reading [tone]
modulation (nominal)	:	± 0.2 deg plus -45 or +10% of reading [V26/201 types]
	:	± 0.2 deg plus -20 or +10% of reading [others]

4.5.5 Phase jitter [4 to 20Hz]

Range (modem signal)	:	0 to 20 deg pk to pk
Range (tone)	:	0 to 30 deg pk to pk
	:	[for tone in range 990Hz to 2200Hz]
Resolution	:	0.1 deg
Accuracy (modem signal)	:	±0.6 deg plus -15 or +5% of reading
Accuracy (tone)	:	± 0.4 deg plus -15 or +5% of reading
Alarm threshold hysteresis	:	3.0 deg

Supplemental characteristics

```
      Weighting filter  :  < 27% of 1Hz phase modulation measured
    edge characteristic :  < 70% of 2Hz phase modulation measured
         (nominal)      :  < 27% of 35Hz phase modulation measured
                        :  <  8% of 50Hz phase modulation measured
```

4.5.6 Amplitude modulation [20 to 300Hz]

```
   Range (modem signal)  :  0 to 20% pk [for PSK]
                         :  0 to 10% pk [for QAM]
           Range (tone)  :  0 to 20% pk [for tone in range 990-2200Hz]
             Resolution  :  0.1% pk
Accuracy (modem signal)  :  ± 0.2% pk plus -10 or +10% of reading
                            [modulation in range 20 to 290Hz]
```

Note: Using V26 or 201 signal types, amplitude modulation of 200Hz ± 10Hz may cause an additional error of up to -10%.

```
          Alarm threshold  :  3.0% pk
            hysteresis
```

Supplemental characteristics

```
      Weighting filter   :  < 9% of 2Hz amplitude modulation measured
    edge characteristic  :  < 27% of 5Hz amplitude modulation measured
         (nominal)       :  < 70% of 10Hz amplitude modulation measured
                         :  < 27% of 500Hz amplitude modulation measured

      Effect of noise
       i.  no jitter     :  20dB S/N ratio will cause < 0.4% nominal amplitude
                            modulation.

      ii. with jitter    :  30dB S/N ratio will cause an additional error
                            of -0.5, +1.5% nominal.
                         :  24dB S/N ratio will cause an additional error
                            of -1.0, +1.5% nominal.

        Accuracy at 300Hz  :  ± 0.2% pk plus -20 or + 5% of reading [tone]
    modulation (nominal)   :  ± 0.2% pk plus -45 or +10% of reading [V26/201 types]
                           :  ± 0.2% pk plus -20 or +10% of reading [others]
```

4.5.7 Amplitude jitter [4 to 20Hz]

```
   Range (modem signal)  :  0 to 20% pk [for PSK]
                         :  0 to 10% [for QAM]
           Range (tone)  :  0 to 20% pk [for tone in range 990-2200Hz]
             Resolution  :  0.1% pk
Accuracy (modem signal)  :  ± 0.6% pk plus -15 or +5% of reading
```

Note: Using V26 or 201 signal types, amplitude jitter of 20Hz ± 1Hz may cause an additional error of up to -5% of reading.

Alarm threshold : 3.0% pk
hysteresis

Supplemental characteristics

Weighting filter :
edge characteristic : < 27% of 1Hz amplitude modulation measured
(nominal) : < 70% of 2Hz amplitude modulation measured
: < 27% of 35Hz amplitude modulation measured
: < 8% of 50Hz amplitude modulation measured

4.5.8 Data spectrum [modem signals only]

Note: Attenuation and Delay Distortion are measured at 32 frequencies spaced across the signal band (at n * baud rate/32 for n = -16....+16) with respect to the carrier frequency (n = 0).

Attenuation and Delay Distortion Nominal Frequency Range - See Table B.

a. Attenuation

Range : +15 to -8dB relative to the carrier frequency
Resolution : 0.1dB
Accuracy : ± 0.3dB [-8dB to +8dB]
± 0.5dB [+8dB to +15dB]

b. Delay

Delay range : -500 to +6000us relative to the carrier frequency
Resolution : 10us
Accuracy : ±70us [for attenuation -8dB to +8dB]
: ±100us [for attenuation +8dB to +15dB]

Supplemental characteristics

Measurement repetition rate : 1 min
Additional error due to noise : ±70us nominal delay and ±0.1dB nominal attenuation with 20dB S/N ratio.
Additional error due to ampl. and phase mod. : ±150us nominal delay & ±0.3dB nominal attenuation with 20 deg p-p phase modulation or 20% peak amplitude modulation.
Additional error due to carrier offset : ±200u nominal delay & ±0.3dB nominal attenuation with 10Hz offset from nominal carrier frequency (see modem signal types).

4.6 Transient Measurements Specification

i. Detection of a dropout disables the counting of phase and gain hits and impulse noise for a period of time beginning when the dropout is first qualified and ending nominally 1 sec after the dropout ends.

ii. Detection and counting of a phase or gain hit does not block the counting of impulse noise.

iii. Phase hits occurring simultaneously with gain hits may not be counted.

iv. A count of ">9999" indicates an overflow.

4.6.1 Dropouts

Threshold	:	12dB below average signal level
Threshold Accuracy (modem signal)	:	+ 4 - 3dB [for QAM] ±2dB [for PSK]
Threshold Accuracy (tone)	:	±2dB for tone
Qualification period	:	4 ms ± 1.5 ms
Deadtime (after end of dropout)	:	1 s ± 50 ms

4.6.2 Phase Hits

Thresholds	:	10 deg ± 1.5 deg
	:	15 deg ± 2.0 deg
	:	20 deg ± 2.5 deg selectable
Qualification period	:	4 ms ± 2 ms
Deadtime	:	125 ms ± 10 ms
Additional Information	:	For some modem signal types, phase hits greater than a specified size and with a rise time less than one baud interval may not be detected: - for V29, V29 (1800Hz) : >20 deg; - for 4 x 4 QAM : >15 deg; - for V27, 208, 2048 : >22 deg A gain hit occurring on a QAM constellation may occasionally cause a phase hit to be recorded.

4.6.3 Gain hits

Thresholds	:	1.0dB ± 0.5dB 2.0dB ± 0.5dB 3.0dB ± 0.5dB 6.0dB ± 1.0dB selectable
Qualification period	:	4 ms ± 2 ms
Deadtime	:	125 ms ± 10 ms
	:	500 ms ± 10 ms [for QAM]
Additional Information (for QAM)	:	For some modem signal types, gain hits greater than a specified size and with a rise time less than one baud interval may not be detected if they are shorter than 200ms: - for V29, V29 (1800Hz) : >1.5dB; - for 4 x 4 QAM : >3dB. In this case the deadtime begins when the hit is first qualified. A phase hit occurring on a QAM constellation may occasionally cause a gain hit to be recorded.

4.6.4 Impulse Noise

Thresholds (relative to RMS line signal level)	:	-18dB -12dB - 6dB 0dB selectable
Deadtime	:	125 ms ± 10 ms
Probability of detection	:	50% ± 15%

Note: Like a modem, the 4948A has a sampling receiver which may not detect all noise impulses. The 4948A's thresholds are set to detect 50% of random impulses at the specified level (impulse shape per IEEE 743-1984 4.4.3)

Supplemental characteristics

The table below shows the nominal size of impulse which will not register any counts at each threshold.

SIGNAL TYPE	THRESHOLD			
	-18dB	-12dB	-6dB	0dB
tone	-20dB	-14dB	-8dB	-2dB
V26, 201 types	-22	-14	-8	-2
V27,208, 2048 types	-20	-14	-8	-4
209 type	-20	-15	-11	-10
209 type fallback	-20	-14	-8	-3
2096 type	-20	-14	-12	-9
2096 type fallback	-20	-14	-8	-3
V29 type	-20	-15	-11	-10
V29 type fallback 1	-20	-14	-9	-8
V29 type fallback 2	-20	-14	-8	-3
V29(1800Hz) type	-20	-14	-10	-9
V29(1800Hz) type fallback 1	-20	-14	-9	-6
V29(1800Hz) type fallback 2	-20	-14	-8	-3

Background noise, phase and amplitude jitter may cause impulse counts depending upon the threshold value. The table below shows nominal values of S/N ratio which may trigger impulse noise thresholds:

SIGNAL TYPE	THRESHOLD			
	-18dB	-12dB	-6dB	0dB
tone	-30	-24	-18	*
V26, 201 types	-32	-26	-20	*
V27,208, 2048 types	-30	-24	-18	*
209, 2096, V29, V29(1800Hz) types	-29	-23	*	*

4.7 Other results

4.7.1 Instrument retrains

These are counted. They may be due to one of the following:

i. excessive impairments [e.g. signal to noise ratio of <15dB for tone, V26, 201 signal types; < 20dB for other signal types]

ii. a dropout nominally > 10sec

iii. a sudden change in the signal characteristics

iv. a change in the signal type.

v. within a signal type, changes from a lower to a higher data rate will cause the receiver to retrain, for example from V29 fallback 2 to V29 fallback 1.

4.7.2 Rate changes

The rate change counter will be incremented in the event of:

i. V29/V29 (1800Hz) :changes from full rate to fallback 1 or 2 or vice versa
:changes from fallback 1 to fallback 2 or vice versa

ii. 209/2096 types :changes from full rate to fallback or vice versa

Installation 6

Introduction

This section provides installation instructions for the Hewlett-Packard Model 4948A In-service Transmission Impairment Measuring Set and its accessories. This section also includes information about preparation for use, packaging, storage and shipment.

Preparation For Use

WARNING

TO AVOID THE POSSIBILITY OF INJURY OR DEATH. THE FOLLOWING PRECAUTIONS MUST BE FOLLOWED BEFORE THE INSTRUMENT IS SWITCHED ON.

(A) NOTE THAT THE PROTECTION PROVIDED BY GROUNDING THE INSTRUMENT CABINET MAY BE LOST IF ANY POWER CABLE OTHER THAN THE THREE- PRONGED TYPE SUPPLIED IS USED TO COUPLE THE AC LINE VOLTAGE TO THE INSTRUMENT.

(B) IF THIS INSTRUMENT IS TO BE ENERGIZED VIA AN AUTO-TRANSFORMER TO REDUCE OR INCREASE THE LINE VOLTAGE, MAKE SURE THAT THE COMMON TERMINAL IS CONNECTED TO THE NEUTRAL POLE OF THE POWER SOURCE.

(C) THE POWER CABLE PLUG SHALL ONLY BE INSERTED INTO A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD WITHOUT A PROTECTIVE CONDUCTOR (GROUNDING).

Power Requirements

The instrument requires a power source of 100 to 120V or 200 to 240V ac. +10% -10%, 48 to 66Hz single phase. The maximum power consumption is 100VA.

Line Voltage Selection and Fuse

The line voltage is selected by the rear panel switch labeled 120V and 240V.

CAUTION

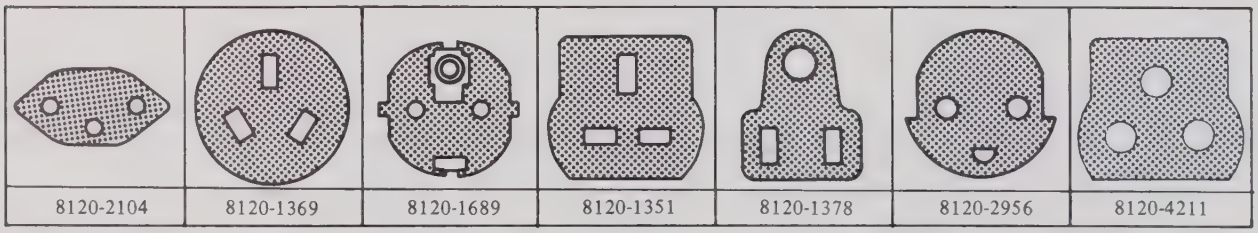
Before connecting the instrument to a power outlet ensure that the line voltage selector is correctly set, and that a fuse of the correct rating is fitted.

Fuse ratings are given in the table below:

Nominal Line	Fuse Rating	HP Part Number
100-120V	3AT/250V	2110-0029
200-240V	1.5AT/250V	2110-0304

Power Cable

This instrument is equipped with a three-wire power cable. When connected to a power outlet, this cable grounds the instrument case. The type of power cable shipped with each instrument depends on the country of destination. Refer to the table below for part numbers of the power cable and plug configurations available. The number shown below each plug is the Hewlett-Packard part number of a power cord equipped with that plug. If the appropriate power cord is not included with the instrument, notify the nearest Hewlett-Packard Sales and Service Office and a replacement will be provided.



8120-2104	8120-1369	8120-1689	8120-1351	8120-1378	8120-2956	8120-4211

The color code used in each power cable is given below:

Line : Brown
Neutral : Blue
Ground : Green/Yellow

Internal Battery

WARNING

THE INTERNAL LITHIUM BATTERY IS NOT RECHARGEABLE. DO NOT SHORT CIRCUIT THE BATTERY TERMINALS. REPLACE WITH THE RECOMMENDED TYPE ONLY. DO NOT INCINERATE OR OTHERWISE MUTILATE THE BATTERY. IT MIGHT BURST OR RELEASE TOXIC MATERIALS CAUSING PERSONAL INJURY.

The lithium battery on A7 is used as a power supply for the non-volatile memory and to run the real time clock. A check of non-volatile memory retention and real time clock operation is performed each time the instrument is powered up. Any failure of these checks can be caused by battery failure and the user is informed by a warning on the display. In this case refer to Section 8 of the Service Manual for the procedure to check battery voltage. Life expectancy of the battery is approximately 5 years.

Operating Environment

Temperature - The instrument may be operated in temperatures from 0 degrees centigrade to +50 degrees centigrade.

Humidity - The instrument may be operated in environments with humidity up to 90%. However, the instrument should also be protected from temperature extremes which may cause condensation within the instrument.

Altitude - The instrument may be operated at altitudes up to 4600m (15,000ft).

Air flow - The air exhaust from the instrument is via a fan mounted on the rear panel. The air intake is via the perforated side panels. To provide adequate cooling, an air gap of approximately 3 inches should be maintained around the instrument.

Mating Connectors

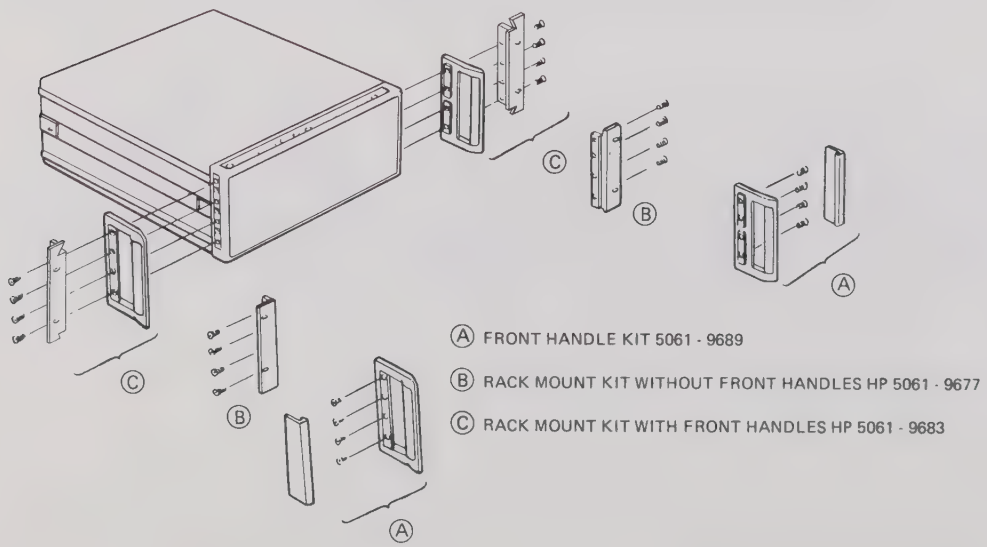
The 4948A receiver and transmitter ports can either be front or rear panel mounted and are either WECO 310 & BANTAM or SIEMENS connectors. The 4948A can either stand alone or be rack mounted.

The mating connector part numbers for all the 4948A ports are listed below.

INSTRUMENT	CONNECTOR	TYPE	MATING CONNECTOR PART NUMBER
Standard, Option 001 and 002	TX, RX1 and RX2	WECO 310 BANTAM	HP 1251-0695 SWITCHCRAFT TT253
Options 003, 004 and 005	TX, RX1 and RX2	SIEMENS	HP 5060-4444
All	HP-IB	AMPHENOL	HP 1251-0293
All	REMOTE (RS-232-C)	25W D SUBMIN	HP 1251-0063 (plug) HP 1251-1438 (hood)
All	PRINTER (RS-232-C)	25W D SUBMIN	HP 1251-0063 (plug) HP 1251-1438 (hood)

Rack Mount

The following rack mount and front handle kits are available with the 4948A.


Ⓐ FRONT HANDLE KIT 5061 - 9689
Ⓑ RACK MOUNT KIT WITHOUT FRONT HANDLES HP 5061 - 9677
Ⓒ RACK MOUNT KIT WITH FRONT HANDLES HP 5061 - 9683

Hewlett-Packard Interface Bus (HP-IB)

This section contains information for installing the 4948A Transmission Impairment Measuring Set into a Hewlett-Packard Interface Bus (HP-IB) system.

The HP-IB is Hewlett-Packard's implementation of the IEEE Standard 488-1978 (Digital Interface for Programmable Instrumentation). This standard defines a physical interface and protocol which enables the remote control of instrumentation systems.

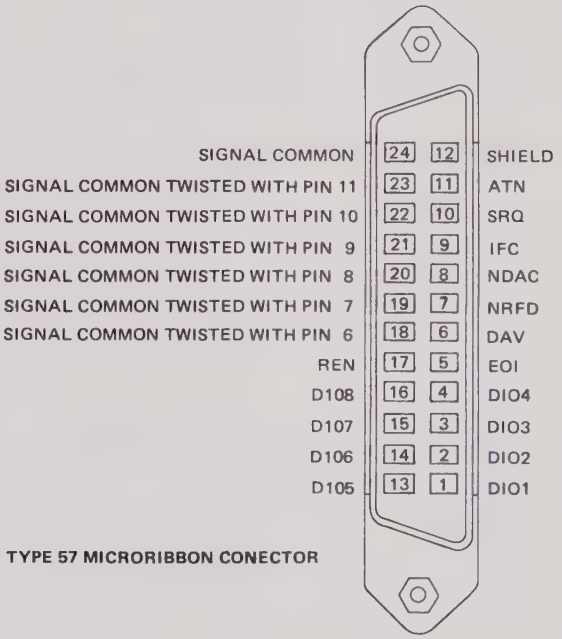
Connection to the HP-IB

Logic Levels

The HP-IB logic levels are TTL compatible i.e. the true (1) state is 0 to 0.5VDC and the false (0) state is +2.5 to 5VDC.

Mating Connector

HP1251-0293;
Amphenol 57-302040



HP-IB (rear panel) Connector

The HP-IB connector on the rear panel of the 4948A provides the physical interface to connect the 4948A into an HP-IB system. The figure above illustrates the connector pin configuration. Devices in the HP-IB system may be interconnected in any suitable arrangement (star, delta, etc) using the HP-IB cables listed in the table below.

Part Numbers	Cable Lengths
HP10833A	1m (3.3ft)
HP10833B	2m (6.6ft)
HP10833C	4m (13.2ft)
HP10833D	0.5m (1.6ft)

To meet design performance, restrictions are placed on the length of HP-IB system cable as follows:

- The total length of HP-IB cable used to interconnect devices on the HP-IB must not exceed 2 meters (6 feet) times the number of devices in the system.
- The total length of HP-IB cable used to interconnect all devices must not exceed 20 meters (65 feet).

The 4948A Printer Control

Refer to the `Using an HP-IB Printer` on Page 2-25 for information on setting up the 4948A with an HP-IB printer.

Results are output in ASCII format to the printer via the rear panel HP-IB connector.

NOTE

Ensure that the printer is set to `LISTEN ALWAYS` and that it is the only device connected to the rear panel HP-IB connector.

The 4948A as an Addressable Device

Setting up the 4948A in the `ADDRESSABLE` mode enables you to control the 4948A remotely via a separate HP-IB controller. This is done from the front panel.

Refer to Page 3-4 for the procedure for information on setting up the 4948A as an `ADDRESSABLE` device. Each device in the HP-IB system requires a unique address to enable the controller to differentiate between devices. The following table provides the character equivalents of HP-IB address codes.

Address	Address Characters	
Decimal	Talk	Listen
0	@	SP
1	A	!
2	B	"
3	C	#
4	D	$
5	E	%
6	F	&
7	G	'
8	H	(
9	I	)
10	J	*
11	K	+
12	L	,
13	M	-
14	N	.
15	O	/
16	P	0
17	Q	1
18	R	2
19	S	3
20	T	4
21	U	5
22	V	6
23	W	7
24	X	8
25	Y	9
26	Z	:
27	[	;
28	\	<
29	]	=
30	~	>

RS-232-C Interface

This section contains information for connecting the 4948A to a RS-232-C interface. The 4948A is configured as Data Terminal Equipment (DTE).

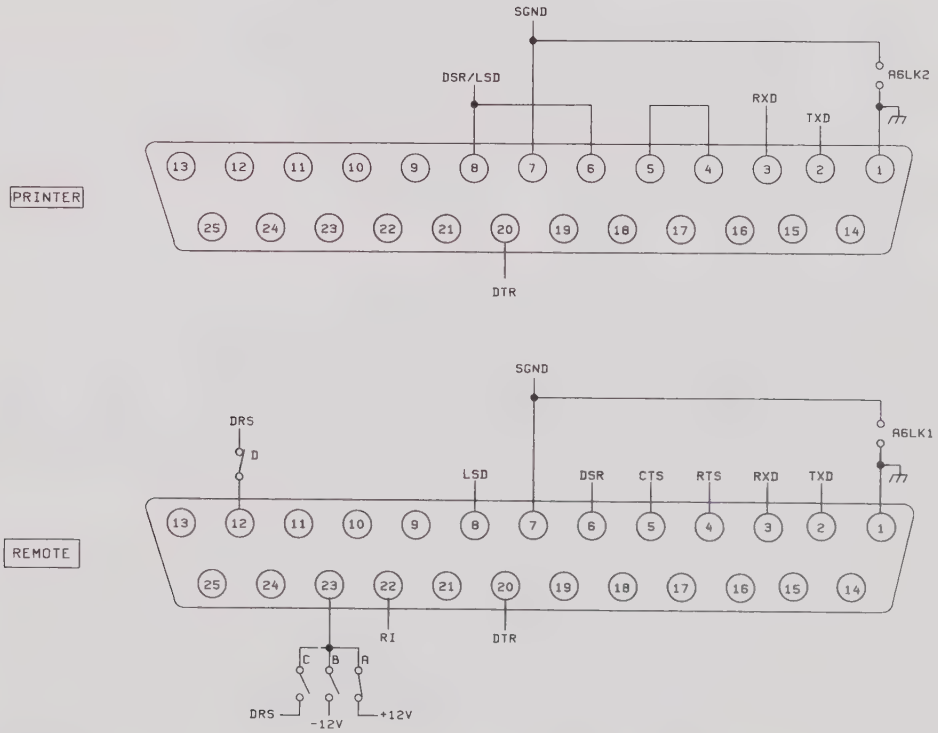
Connection to the RS-232-C System

Logic Levels

The RS-232-C functions are ON when the voltage at the receiver is more positive than +3V and OFF when more negative that -3V. The function is not defined in the transition region between +3V and -3V.

Mating Connector

HP1251-0063 (plug)
HP1251-1438 (hood)



RS-232-C Interface Cables

The RS-232-C cables are discussed under "Cabling" in the "Preparing the 4948A for RS-232-C Remote Control" on page 3-11 and 3-12.

RS-232-C Printer Control

Refer to Page 2-25 for information on setting up the 4948A to print results via the RS-232-C interface.

RS-232-C Remote Control

Refer to Page 3-8 for all relevant information on Preparing the 4948A for RS-232-C Remote Control.

Dual Rate Modems (data rate selection)-CH/CI

Some modems can operate at two data rates. Normal operation is at the higher rate, e.g. 1200 bps, but if the circuit quality is poor and causing errors then the modem can be switched to a "fallback" rate, say 300 bps, which, although slower, is less error sensitive.

RS-232-C defines two circuits, CH and CI, as data rate selectors. The circuit definitions are identical except that CH is sourced by the DTE, whilst CI is sourced by the DCE. CH is used where the DTE is controlling the transmission speed, for example, at the "originate" end of a dialup line. CI is used where the modem is indicating received transmission speed so that the DTE can adapt to it - for example at the "answer" end of the dialup line.

The two circuits are functionally mutually exclusive and have both been assigned to pin 23 of the RS-232-C The decision as to which circuit to implement, i.e. whether the DTE or DCE is to source the signal, is left to the modem manufacturer. However, a dual-speed modem that can be used to originate or answer a data transmission ideally needs both circuit CH and circuit CI.

The widely adopted solution is to use the normal pin, 23, for circuit CH and to redefine pin 12 (normally Secondary Received Line Signal Detect) as circuit CI.

A set of switches on the 4948A rear panel connector assembly, A6, accommodate different configurations of the data rate CH/CI functions. The instrument is shipped with switches in the position shown in "Connection to the RS-232-C System" (Page 6-8) which is compatible with AT & T 212A-type modems).

The following examples show how the switches are used to prepare the 4948A for connection to a dual rate modem.

Example 1 - Setting the 4948A to adapt to the modem speed (e.g. at the "answer" end of a dialup line, or at one end of some leased lines).

The 4948A can adapt to the modem speed if the modem provides circuit CI.

	Switch Settings			
	A	B	C	D
If CI is on pin 23 If CI is on pin 12*	Open Closed	Open Open	Closed Open	Open Closed

Example 2 - Setting the 4948A to control the modem speed (e.g. at the "originate" end of a dialup line, or at one end of some leased lines).

The 4948A can control the modem speed if the modem has circuit CH on pin 23 of its RS-232-C connector.

	Switch Settings			
	A	B	C	D
To select the higher speed To select the lower speed	Closed Open	Open Closed	Open Open	Open Open

*The instrument is shipped with the switches in this position.

Manual Control Of DTR

Normally, when the 4948A is configured for modem connection, it holds DTR (Data Terminal Ready) signal permanently on. However, manual control of Data Terminal Ready is available via an additional front panel control. If switch S5 on assembly A7 is set to the "1" prior to switching the 4948A on. The display will then be as follows:

```
REMOTE CONTROL▸ RS232C          ▸ part 1
CONNECTION▸ modem          DUPLEX▸ full
ENQ/ACK▸ on               XON/XOFF▸ off
DTR▸ off
```

DTR (Data Terminal Ready) can be turned on prior to manually originating or answering a call, or it will turn on automatically in response to a signal on Ring Indicator.

DTR on the display will always reflect the state of the Data Terminal Ready signal at the interface.

During the progress of a call Data Terminal Ready will be on, but can be manually turned off to cause the modem to disconnect.

In all cases, if DSR (Data Set Ready) does not turn on within 60 seconds of DTR (Data Terminal Ready) being turned on then DTR (Data Terminal Ready) will turn off. If Data Set Ready turns off, for example at the end of a call then Data Terminal Ready will turn off.

As for normal operation, Data Terminal Ready and Data Set Ready must be on before communications can proceed.

Storage And Shipment

Environment

The instrument may be stored or shipped in environments within the following limits:

Temperature	-40 degrees centigrade to +75 degrees centigrade
Humidity	90%
Altitude	15,300m (50,000ft)

The instrument should also be protected from temperature extremes which may cause condensation within the instrument.

Packaging

Tagging for Service - If the instrument is being returned to Hewlett-Packard for service, please complete one of the blue repair tags located at the front of the service manual and attach it to the instrument.

Original Packaging - Containers and material identical to those used in the factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number and full serial number. Also mark the container "FRAGILE" to ensure careful handling.

Other Packaging - The following general instructions should be used for re-packing with commercially available materials:

(a) Wrap instrument in heavy paper or plastic. (If shipping to Hewlett-Packard office or service center, attach a tag indicating type of service required, return address, model number and full serial number.)

(b) Use strong shipping container. A double-walled carton of 350- pound test material is adequate.

(c) Use a layer of shock absorbing material 70 to 100mm (3 to 4 inch) thick around all sides of the instrument to provide firm cushioning and prevent movement inside the container. Protect the control panel with cardboard.

(d) Seal shipping container securely.

(e) Mark the shipping container fragile to ensure careful handling.

(f) In any correspondence, refer to instrument by model number and full serial number.

Error Codes

A

Error Codes may be generated as a result of remote programming of the 4948A.

Code	Description
	Parser errors
-100	Unrecognised command
-110	Error in command header syntax
-120	Error in numeric syntax
-121	String data given where a number is expected
-123	Number too big to store (range -32768. . . . .+32767)
-132	Numeric data given where a string is expected
-134	String parameter too long
-141	Command too long
-142	Too many parameters in command
-143	Illegal data separator
-144	Illegal end of message delimiter
-145	Command header too long
-146	EOI occurs within " "
-147	Block data not implemented
-148	Character data not implemented
-149	Data outside allowed limits
-150	Not enough parameters with command
	RS-232-C interface errors
-160	Parity error
-161	Framing error
-162	Overrun error
-163	Input buffer overflow
	Executor errors
-201	Not executable in local mode
-204	Not executable when instrument is stopped
-205	Not executable when instrument is started
-206	Not executable when instrument is not logging
-207	Not executable when instrument is logging
-208	Not executable via HP-IB interface
-209	Not executable via RS-232-C interface
-210	Not executable in this operating mode
-220	Test not executable via HPIB
-221	Test not executable via RS-232-C
-222	Service item not executable via HPIB
-223	Service item not executable via RS-232-C

Non-programming **internal errors** can also be displayed. If these appear or if any positive(+) error code is diplayed, consult the Service Manual.

Internal Errors

-310 Nonvolatile Memory RAM Error
-330 Power on test failed
-340 Self test failed
-350 Real Time Clock Error

The error codes may be displayed (see typical display below) or they may be read remotely, using the **ERR?** command.

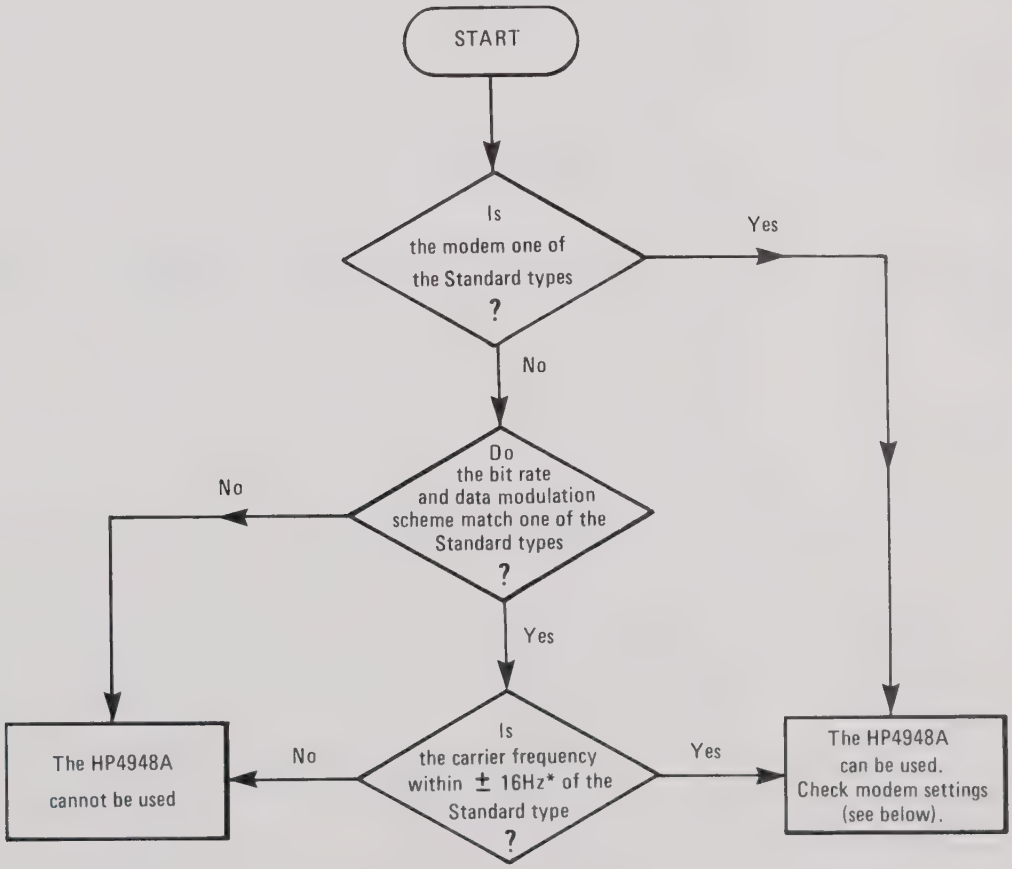
```
>> PROGRAMMING ERROR   -100  <<

   CONSULT OPERATING MANUAL
   PRESS ANY KEY TO RECOVER
```

Suitable Modems and Circuits B

Suitable Modem Signals

The 4948A is designed to operate with any of the common standard modem types (AT&T and CCITT) shown in Table A on Page 5-4. The AT&T schemes are sometimes referred to as "Bell" schemes as that was their name before the AT&T divestiture.

The 4948A can also operate with modem signals which are similar to the standard types. To confirm if the 4948A can operate with a a specific modem signal, make the following checks:


START
Is the modem one of the Standard types ?
Yes
No
Do the bit rate and data modulation scheme match one of the Standard types ?
No
Yes
Is the carrier frequency within ± 16Hz* of the Standard type ?
No
Yes
The HP4948A cannot be used
The HP4948A can be used. Check modem settings (see below).

*Within 10Hz operation is warranted; 10Hz and 16Hz operation is expected to be similar but is not warranted. These offset limits apply to the combination of carrier offset in the modem and frequency shift in the channel.

Modem Settings

Many modems offer several modes of operation selectable by internal straps or switches. Options often include a choice of modulation scheme; carrier frequency (sometimes related to a diagnostic mode); and scrambler length (sometimes related to training time).

For example, a modem described as "V.29-compatible" many also be capable of non-V.29, proprietary modulation schemes and data-scrambling algothrithms - and may in fact be shipped with a non-standard setting.

If a modem uses a non-standard modulation scheme or an unsuitable carrier frequency (see flowchart), the 4948A will not be able to train or measure on its line signal. If a modem uses a non-standard, short scrambler, the line signal during data transmission will usually be random enough to allow the 4948A to train and measure; but if the modem is idle, the 4948A may not train (though if already trained it will measure on this signal).

To allow in-service testing by the 4948A, modems must generate a standard signal with standard scrambling.

Random Data

Most data signals are random since most high speed modems scramble data as part of their modulation process. In addition, data is often encrypted for security purposes.

When a signal is non random, not all the constellation points are equally present, so the 4948A cannot measure so accurately. V.26 and 201 type modems do not scramble data. If the line signal is non-random, the 4948A detects the condition - results are not warranted and the instrument displays a warning message - "Uncalibrated".

Point-to-Point Circuits

Point-to-point circuits are used where there is data communication between two devices in two separate locations, and the 4948A can measure at any point in the usual way.

In some point-to-point circuits high speed modems are used with multiplexers which allow a number of lower speed devices to share the same communications circuit. The multiplexer may or may not be integrated with the modem. The analog signal from the modem is unaffected by the multiplexing process and so, provided the modulation scheme is suitable, the 4948A may be used to measure on the line signal in the normal way.

Multi-point Circuits

Multi-point (or mult-drop) circuits are another way in which a number of devices can share a communications channel. A central (Host) computer's resources can be shared by a number of terminals (Slaves) separated in some cases by large distances.

The signal on the circuit from the Host modem to the Slaves is continuous, with address information included in the data that is decoded and recognized by the addressed Slave. The 4948A can be used at any point in this part of the circuit.

The return circuit, from the Slaves to the Host, is time-shared among all the terminals with each burst of data typically lasting a few hundred milliseconds. This is not enough time for the 4948A to recognize the signal.

To use an 4948A in this circuit, a slave must transmit data for a time long enough for the test set to make its measurements: at least one minute. This generally requires the network operator to activate a loopback or force a modem to transmit a long signal. This will affect the normal operation of the network as there will be no communication from any other Slaves for the period of the test.

MANUAL CHANGES

MANUAL IDENTIFICATION
Model Number: 4948A
Date Printed: Jan 1987
Part Number: 04948-90001

Operating Manual

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections.

Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix or Number	Make Manual Changes
2615U	No Change
2615U00248	Change 1*
and above	
including 159,167,	
190,192,193,204,	
206,207,212,218,	
219,227,229-238,	
243-245	
2615U00256	Change 2*
and above	

Serial Prefix or Number	Make Manual Changes

* NEW ITEM

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of the supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement or the model number and print date from the title page of the manual.

17 Feb 1988

HEWLETT PACKARD

Printed in U.K.

ERRATA

*Page 1-4, Step 2:
Change to: To operate the 4948A remotely via the RS232C interface using a modem, then the cable supplied can be used for connection to the REMOTE CONTROL port, refer to Page 3-15. For hardwired RS232C control where a controller or terminal is connected directly to the REMOTE CONTROL port refer to Page 3-11

Step 3:
Add: The RS232C cable supplied with the instrument can be used to connect the printer.

Page 1-5:
Add: RS232-C Cable (Part No 5060-4461)

The RS232-C cable supplied is intended to be used for connecting Data Terminal Equipment (DTE) to/from Data Communication Equipment (DCE).

The 4948A RS232-C REMOTE port is configured as DTE and the cable is used with this port where remote control is via a modem (DCE). Refer to Section 3 "Preparing the 4948A for RS232-C Remote Control" for further information.

The 4948A RS232-C PRINTER port is configured as DCE and the cable can be used for connection to an RS232-C printer (DTE). Refer to Section 2 "Printing Results" for further information.

RS232-C TEST PLUG (Part No 5060-4462)

The RS232-C test plug supplied is used for 4948A Servicing Operations. Refer to the Service Manual for further information.

Page 2-9:
Add the following Threshold Settings information (follows on from last item on page 2-9).

THRESHOLD SETTINGS

Thresholds should be chosen with care: tight thresholds may be triggered unnecessarily, while slack thresholds may not detect problems. The correct values for a particular situation depend on the type of circuit and the robustness of the modem.

ERRATA (continued)

The following is a set of practical values for result thresholds which should not normally be triggered on a working circuit.

Level	:	+/-6dB with respect to nominal#
Frequency	:	+/-6Hz with respect to nominal#
S/N	:	22dB
Phase Jitter	:	10 degrees
Phase modulation	:	10 degrees
Amplitude jitter	:	10%
Amplitude modulation	:	10%
Phase hits	:	10-20 degrees (see comments on Phase Hits)
Gain hits	:	3dB
Impulse Noise	:	-6dB (see comments on Impulse Noise)

#Level and frequency should be measured in normal operation and limits set with respect to these values.

Phase Hits

There is a theoretical limit to phase hit measurement on a modem signal. As a result, the 4948A will not count every phase hit, and in selecting a suitable phase hit threshold a compromise has to be reached between an angle which is so small that every phase excursion will be counted and one which is so large that the probability of counting a phase hit is very small or even zero. Recommended maximum thresholds are shown in the table below.

This problem does not exist then measuring on a single tone, since there are no decision boundaries.

Recommended maximum phase hit thresholds

Signal Type	Recommended maximum setting for hit threshold (degrees)
209, 2096	10
V.27, V.29, V.29 (1800) 208, 2048	15
V26A, B.201 tone	20

ERRATA (continued)

Impulse Noise

As for any impulse noise test set, if thresholds are set too low, they may be triggered by peaks of the background noise on the channel. As a result, a threshold setting of -12dB is recommended for most channels, -6dB for noisy ones.

Page 2-26:
Add: The 4948A RS232-C PRINTER port is configured as DCE. RS232-C cable (Part No 5060-4461) can be used to connect to an RS232-C printer (DTE).

Page 3-9:
Change: "The 4948A RS232-C interface is configured as a DTE" to
"The 4948A RS232-C REMOTE interface is configured as a DTE"

*Page 3-9 & 3-35:
Add: Note: The CI circuit at pin 23 can be switched to pin 12 for use with dual rate modems, see Pages 3-39 & 6-9 for details. The factory preset condition is CI on pin 12.

*Page 3-39:
Add: The factory preset condition is CI on pin 12.

Page 4-14:
In "Explanation" column - second last line - change title to tilde (~).

Page 4-42, Status Reporting:
On line two of the first paragraph:
Change: (see Page 4-46) to (see Page 4-43)

*Page 4-42:
Add (at the bottom of page):
The BREAK statement directs the HP 98628A to send a break sequence. A logic high (SPACE) is transmitted for a duration equal to 4 character periods. For the BREAK to be recognized by the 4948A a (SPACE) duration of >3 character periods is recommended.

ERRATA (continued)

Page 4-58:
In "Note" at the bottom of the page:
Change: "RTSP" to "RSTP"

*Page 4-58, DSP Command:
Before NOTE add:
In this mode the KEY? command can be used to detect the Front Panel key that is pressed. Refer to KEY?.

Page 4-59:
In "ASCII Code" column in the table:
Change: "0-31" to "8-31"

*Page 4-59:
After Table add:
For RS232C control avoid the use of codes 5 & 6 if ENQ/ACK handshake is being used or codes 17 and 19 if XON/XOFF is being used. These could be misinterpreted as control characteristics.

Page 4-66:
Change: <minutes> = "0 to 69" to <minutes> = "0 to 59"

Page 4-67:
Replace table at top of page with the following:

Code	Status
1	No logged results.
2	Requested time earlier than earliest event log.
3#	Requested time lies between the earliest event and the end of the log.
4#	Requested time is later than the end of the log.

#If the instrument is running and logging events then the end of the log is defined as the current time. If the instrument is stopped, the end of the log is the log stop time.

ERRATA (continued)

Page 4-68:
At the top of the page:
Change: "0 or 1" to "0 to 9"

Page 4-69
Replace the table at the bottom of the page with the following:

Code	Status
1	No logged results.
2	Requested time is earlier than the beginning of the earliest period in the log.
3	Requested time lies between the beginning of the earliest period in the log and the end of the latest period in the log.
4	The requested time is later than the end of the latest period in the log.

Page 4-75:
In table change "measurement" to "measurements"

Page 4-86:
Change Impulse Noise Threshold default setting from "2dB" to "-12dB"

Page 4-87, SER? .. ..Serial Number Query:
On the last line of the page:
Change: <serial number> = typical value is "2654U00000" to
<serial number> = <YYWW>U00000
where <YYWW> = firmware rev (see REV? on Page 4-83)
U = country of origin
00000 = dummy serial number suffix

Page 5-4:
Replace Page 5-4 with the following:

ERRATA (continued)

RS-232-C	Remote Control Interface	80-column Printer Interface
Connector	25 way female D-type ISO 2110-1980 pin assignment [DTE configuration]	25-way female D-type ISO 2110-1980 pin assignment [DCE configuration]
Bit rates (bit/s)	300,600,1200,1800,2400	110,150,200,300,600,1200,1800,2400
Connections	Hardwired, dial-up, leased	
Modes	Asynchronous, half or full duplex	
Word length	7 bits	7 bits
Parity	Odd, even, mark, space	Odd, even, mark, space
Stop Bits	One or two	One or two
Handshake	None, XON/XOFF and ENQ/ACK	DTR, XON/XOFF or ENQ/ACK

Specification referring to V29, V29 (1800Hz), 209 or 2096 types include their respective fallback signals (see 4.2.2).
Specifications referring to QAM or PSK are based on column 3 of Table A and 4.2.2

Table A - Modem signal type definitions

Search Order	Modem signal type	Data modulation	Baud rate	Expected carrier freq. (Hz)	Bit rate (bits/sec)
1.	CCITT V26 A	4-PSK	1200	1800	2400
	CCITT V26 B AT & T 201 B/C	4-PSK [+45 db/baud]	1200	1800	2400
2.	CCITT V27	8-PSK	1600	1800	4800
	AT & T 208/2048	8-PSK [+22.5dg/baud]	1600	1800	4800
3.	CCITT V29	V29 QAM	2400	1700	9600
4.	AT & T 2096	4*4 QAM	2400	1800	9600
5.	AT & T 209	4*4 QAM	2400	1650	9600
6.	CCITT V29 (1800Hz)	V29 QAM	2400	1800	9600

Note: CCITT V29 (1800Hz) type refers to a modem signal with a modulation scheme as defined in CCITT V29 but with a carrier frequency of 1800Hz. AT & T is a trademark of the American Telephone & Telegraph Company.

ERRATA (continued)

Page 5-6, 4.2.2 Receive Modem Signal:
Add: Fall back signals (see Page 5-7) are identified at the same stage as the parent signal.

Page 5-9:
Replace page 5-9 with the following:

Measurement Availability

Available when this stage is reached	Measurements	Signal type			
		V29,209, 2096 & V29 (1800Hz)	V26,201, V27,208 & 2048	tone	V26/201 non random data
"training stage 1"*	SIGNAL LEVEL	Y	Y	Y	Y
"training stage 2"	CARRIER FREQUENCY	Y	Y	Y	Y
"trained" or "all measurements available"	SIGNAL/NOISE RATIO	Y	Y	Y	Y
	PHASE MODULATION (20-300Hz)	Y	Y	Y	Y
	PHASE JITTER (4-20HZ)				
	AMPLITUDE MODULATION (20-300Hz)	Y	Y	Y	Y
	AMPLITUDE JITTER (4-20Hz)	Y	Y	Y	Y
	DATA SPECTRUM				
	a. ATTENUATION and	Y	Y		
	b. DELAY	Y	Y		
	DROP OUTS	Y	Y	Y	Y
	PHASE HITS	Y	Y	Y	Y
	GAIN HITS	Y	Y	Y	Y
	IMPULSE NOISE	Y	Y	Y	Y
	INSTRUMENT RETRAINS	Y	Y	Y	Y
	DATA RATE CHANGES	Y			

*When automatic modem signal identification is in progress, signal level becomes available when training stage 2 is reached.

Receiver training stage 1 normally completes in a few seconds.

Receiver training stage 2 normally completes within the times shown for each signal type.

tone : 40s
V26, 201 : 95s
V27, 208, 2048 : 70s
V29, 209, 2096, V29 (1800Hz) : 50s

ERRATA (continued)

Page 5-15, 4.6.2 Phase Hits:
Replace "Additional Information" with the following:

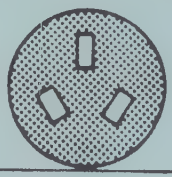
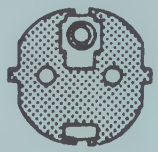
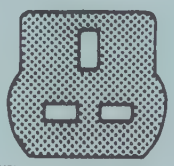
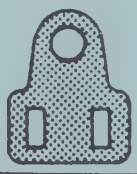
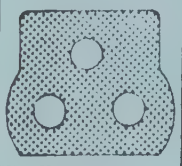
Additional Information	:	For some modem signal types, phase hits greater than a specified size and with a rise time less than one baud interval may not be detected: - for V29 QAM, V29 (1800Hz) QAM : >20 deg; - for 4 x 4 QAM : >15 deg; - for V27, 208, 2048 : >22 deg A gain hit occurring on a QAM constellation may occasionally cause a phase hit to be recorded.

Page 5-16, 4.6.3 Gain Hits:
Replace "Deadtime" and "Additional Information" with the following:

Deadtime	:	125 ms ± 10 ms
	:	500 ms ± 10 ms [for V29, V29 (1800Hz), 209, 2096]
Additional Information (for QAM)	:	For some modem signal types, gain hits greater than a specified size and with a rise time less than one baud interval may not be detected if they are shorter than 200ms: - for V29 QAM, V29 (1800Hz) QAM : >1.5dB; - for 4 x 4 QAM : >3dB. In this case the deadtime begins when the hit is first qualified. A phase hit occurring on a QAM constellation may occasionally cause a gain hit to be recorded.

ERRATA (continued)

*Page 6-2, Power Cable Diagram:
Change to the following:

						
8120-2104	8120-1369	8120-1689	8120-1351	8120-1378 US	8120-2956	8120-4211
				8120-4753 JAP		

Page 6-8, RS232C Interface:
Add: The REMOTE port is configured as Data Terminal Equipment (DTE). The PRINTER port is configured as Data Communications Equipment (DCE).

RS232C Interface Cables

The cable supplied with the instrument gives straight through connection of pins 1 to 8, 12, 20, 22 and 23. These are the pins used by the 4948A.

The cable is intended for connection of the REMOTE port to a modem or for connection of the PRINTER port to a printer. Refer to Page 3-15 for modem connection or to Page 2-25 for printer operation. It can also be used with the REMOTE port for hardwired connection of a Controller or Terminal depending on the configuration of the control equipment interface. Refer to Pages 3-11 and 3-12.

Because all of the RS232C control signals may not be required for every configuration, simpler cabling arrangements can be employed. For instance, with most printers the straight through connection of pins 2, 3 and 7 is sufficient.

Page 6-11:
Change: "Temperature.....-40°C to +75°C" to
"Temperature.....-20°C to +70°C"

*CHANGE 1

The main features of this change are:

* An additional OPERATING MODE "Tx/Rx Demo V27" for demonstration purposes.

* An additional modem type "4x4 QAM (1700Hz)" for receive modem measurement.

Page x INITIAL INSPECTION, CONTENTS:
Add: Front Panel Protective Cover Kit (Part No. HP 15672A)

Page 1-1, Introduction:
Change: "The three demonstrations" to "The four demonstrations"
Add: "• a back to back demonstration" before • in-service testing.

Page 1-7, Before Demonstration 1:
Add: Demonstration 0

In this demonstration a built in demo feature of the 4948A is used. The 4948A produces a V27 type test signal with steady state and trained impairments. The 4948A receiver is used to monitor this signal and measure the impairments.

1. Display the OPERATING MODE page then select "tx/rx demo V27 type" and set the MODEM SELECTION to "automatic".

2. Display the ANALOG PORTS page and set the INPUT to "RX1", RECEIVER IMPEDANCE to "600ohms", "terminated". Set the TRANSMIT IMPEDANCE to "600ohms". Connect the TX port to RX1 port.

3. Display the RECEIVER STATUS page.

4. Press START/STOP key. The display will give a WARNING to indicate that the receiver is in terminate mode.

5. Press the START/STOP key (RUN led will light). The received modem signal can be heard on the audio MONITOR, adjust the VOLUME control if required.

6. Before making measurements, the 4948A must identify the modem signal. While identification progresses, messages are displayed on the RECEIVER STATUS page.

7. When "all measurements available" is displayed, set the display to the CURRENT page and use the CHANGE key to step through the results.

*CHANGE 1 (continued)

8. Typical results will be:

signal level - -9.7dBm
S/N ration - 28.9dB
phase modulation (20-300Hz) - 4.8 degrees
dropouts - 1 per minute

data spectrum will show attenuation variation with frequency.

9. Demonstration 2 shows how a hardcopy of these results can be obtained.

Page 1-9:
Add: Demonstration 2 can also be used to obtain a hardcopy of Demo 0 results. In step 10 for a plot of data spectrum set to PRINT "data spectrum".

Page 2-4, Line 4:
Change: "There are three modes" to "There are three main modes"
Add: "A further mode, tx/rx demo V27, is also provided for demonstration purposes only. See Section 1, Demonstrating the 4948A, for details of operation in this mode."

Pages 2-4 & 2-6:
Add (to list of modem signals): "4x4 QAM (1700Hz) type"

Page 2-29:
Change: "• group delay v frequency" to "• delay v frequency"

Page 2-30:
Delete: "Group"

Pages 4-3 and 4-77, Command OPRM:
Change: "<selector> = 1 to 3" to "<selector> = 1 to 3 and 6 or 1 to 6 (dependent on internal service switch setting. Refer to service manual for details of Operating Modes 4 & 5, Self Test and Service)."

Add to table Operating Mode: "Tx/Rx demo V27 type", Command "OPRM6"

Pages 4-4 and 4-81, Command RCVM:
Change: "<selector> = 1 to 6" to "<selector> = 1 to 7"

Add to table: "4x4 QAM (1700Hz) type", "RCVM7".

*CHANGE 1 (continued)

Pages 4-5 and 4-93, Command TRNM:
Change: "<selector> = 1 to 10" to "<selector> = 1 to 11"

Add to table: "4x4 QAM (1700Hz) type", "TRNM11"

Pages 4-13 and 4-85, RMSS table:
Change Code/State range from 1 to 15 to 1 to 17.

Add: "16 trying 4x4 QAM (1700Hz) type"
"17 found 4x4 QAM (1700Hz) type"

Page 5-4, Table A:
Add to end of table, in columns.
Add: "7 , 4*4 QAM (1700Hz), 4*4 QAM, 2400, 1700, 9600"

Page 5-5, Table B:
Add beside V29 Modem Signal Type: "4*4 QAM (1700Hz)"

Page 5-6, Attenuation and Delay Table:
Add beside V29 etc: "4x4 QAM (1700Hz)"

Page 5-7, Fallback States in Received Modem Signals:
Change: "V29 or V29 (1800Hz) type modems" to
"V29, V29 (1800Hz) or 4*4 QAM (1700Hz) type modems"

Add Paragraph 4.2.3 tx/rx demo V27 type:

In this mode, an impaired V27 signal is transmitted and received simultaneously. Modem selection can be manual or automatic. When manual is selected, the modem type is fixed as V27. When automatic is selected, this V27 type signal is transmitted while the receiver is trying V26 and V27 signal types. This allows the automatic modem search to be demonstrated. When tx/rx demo V27 type is selected, the receiver cannot operate with an external signal source.

The transmitted V27 type signal has the following nominal characteristics:

signal level - -9.7dBm
S/N ratio - 28.9dB
phase modulation (20-300Hz) - 4.8 degrees
dropouts - 1 per minute after "all meas available" is reached

Page 5-9, Receiver Stage 2 times:
Change: "V29, 209, 2096, V29 (1800Hz)" to
"V29, 209, 2096, V29 (1800Hz), 4x4 QAM (1700Hz)"

Page 5-10, Supplemental characteristics:
Add, at +0.25dB Signal level compensation factors: "4*4 QAM (1700Hz)"
Add, at 0.85sec Nominal averaging time "4x4 QAM (1700Hz)"

CHANGE 1 (continued)

Page 5-17, Nominal Impulse Size Table:

Add:	4*4 QAM (1700Hz) type	-20	-15	-11	-10
	4*4 QAM (1700Hz) type fallback 1	-20	-14	-9	-8
	4*4 QAM (1700Hz) type fallback 2	-20	-14	-8	-3

At table of nominal S/N ratio beside:

"209, 2096, V29, V29 (1800Hz)" add: "4*4 QAM (1700Hz) type"

*CHANGE 2

Serial numbers 256 and above.

Page 6-2, X-Y Outputs:
Change "100ohm nominal" to "1Kohm nominal"

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EDMONTON, Alberta T5S 1P2
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SALES & SUPPORT OFFICES

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C

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CM,E,M

Metrolab S.A.
Monjitas 454 of. 206
SANTIAGO
Tel: 395752, 398296
Telex: 340866 METLAB CK
A

Olympia (Chile) Ltda.
Av. Rodrigo de Araya 1045
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SANTIAGO 21
Tel: 225-5044
Telex: 340892 OLYMP
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Cable: AARIS Bogota
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Blue Star Ltd.
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13 Community Center
New Friends Colony
NEW DELHI 110 065
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PUNE 411 011
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A,E

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T.C. 7/603 Poornima
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TRIVANDRUM 695 013
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TEL-AVIV
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ABIDJAN 01
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Yokogawa-Hewlett-Packard Ltd.
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Tel: (0222) 25-1011
C,E

Yokogawa-Hewlett-Packard Ltd.
Nagoya Kokusai Center Building
47-1, Nagono, 1 Chome
Nakamura-ku
NAGOYA, 450
Tel: (052) 571-5171
C,CM,E,M

Yokogawa-Hewlett-Packard Ltd.
Saikyoren Building
1-2 Dote-machi, **OHMIYA**
Saitama 330
Tel: (0486) 45-8031

Yokogawa-Hewlett-Packard Ltd.
Chuo Bldg.,
4-20 Nishinakajima, 5 Chome
Yodogawa-ku
OSAKA, 532
Tel: (06) 304-6021
Telex: YHPOSA 523-3624
A,C,CM,E,M,P*

Yokogawa-Hewlett-Packard Ltd.
27-15, Yabe, 1 Chome
SAGAMIHARA Kanagawa, 229
Tel: 0427 59-1311

Yokogawa-Hewlett-Packard Ltd.
Daiichi Seimei Bldg.
7-1, Nishi Shinjuku, 2 Chome
Shinjuku-ku,**TOKYO** 160
Tel: 03-348-4611
C,E

Yokogawa-Hewlett-Packard Ltd.
29-21 Takaido-Higashi, 3 Chome
Suginami-ku **TOKYO** 168
Tel: (03) 331-6111
Telex: 232-2024 YHPTOK
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Yokogawa Hokushin Electric Corp.
9-32 Nokacho 2 Chome
2 Chome Musashino-shi
TOKYO, 180
Tel: (0422) 54-1111
Telex: 02822-421 YEW MTK J
A

Yokogawa-Hewlett-Packard Ltd.
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Utsunomiya Odori Building
1-5 Odori, 2 Chome
UTSUNOMIYA, Tochigi 320
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C,E

Yokogawa-Hewlett-Packard Ltd
Yasuda Seimei Yokohama Nishiguchi Bldg
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YOKOHAMA 221
Tel: (045) 312-1252
C,E

JORDAN

Scientific and Medical Supplies Co
P.O. Box 1387
AMMAN
Tel: 24907, 39907
Telex: 21456 SABCO JO
C,E,M,P

KENYA

ADCOM Ltd., Inc., Kenya
P.O.Box 30070
NAIROBI
Tel: 331955
Telex: 22639
E,M

KOREA

Samsung Hewlett-Packard Co. Ltd.
Dongbang Yeoeuido Building
12-16th Floors
36-1 Yeoeuido-dong
Yongdeungpo-ku
SEOUL
Tel: 784-2666, 784-4666
Telex: 25166 SAMSAN K
A,C,CM,E,M,P

Young In Scientific Co., Ltd.
Youngwha Building
547 Shinsa Dong, Kangnam-ku
SEOUL 135
Tel: 5467771
Telex: K23457 GINSCO
A

KUWAIT

Al-Khaldiya Trading & Contracting
P.O. Box 830
SAFAT
Tel: 424910, 411726
Telex: 22481 AREEG KT
Cable: VISCOUNT
E,M,A

Gulf Computing Systems
P.O. Box 25125
SAFAT
Tel: 435969
Telex: 23648
P

Photo & Cine Equipment
P.O. Box 270
SAFAT
Tel: 2445111
Telex: 22247 MATIN KT
Cable: MATIN KUWAIT
P

W.J. Towell Computer Services
P.O. Box 5897
SAFAT
Tel: 2462640
Telex: 30336 TOWELL KT
C

LEBANON

Computer Information Systems S.A.L.
Chammas Building
P.O. Box 11-6274 Dora
BEIRUT
Tel: 89 40 73
Telex: 42309
C,E,M,P

LIBERIA

Unichemicals Inc
P.O. Box 4509
MONROVIA
Tel: 224282
Telex: 4509
E

MADAGASCAR

Technique et Precision
12, rue de Nice
P.O. Box 1227
101 **ANTANANARIVO**
Tel: 22090
Telex: 22255
P

LUXEMBOURG

Hewlett-Packard Belgium S.A./N.V.
Blvd de la Woluwe, 100
Woluwedal
B-1200 **BRUSSELS**
Tel: (02) 762-32-00
Telex: 23-494 paloben bru
A,C,CM,E,M,P

MALAYSIA

Hewlett-Packard Sales (Malaysia) Sdn. Bhd.
9th Floor
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46, Jalan Raja Laut
KUALA LUMPUR
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Telex: 31011 HPSM MA
A,C,E,M,P*

Protel Engineering
P.O.Box 1917
Lot 6624, Section 64
23/4 Pending Road
Kuching, **SARAWAK**
Tel: 36299
Telex: 70904 PROMAL MA
Cable: PROTELENG
A,E,M

MALTA

Philip Toledo Ltd.
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Notabile Rd.
MRIEHEL
Tel: 447 47, 455 66
Telex: 1649
E,M,P

MAURITIUS

Blanche Birger Co. Ltd.
18, Jules Koenig Street
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Tel: 20828
Telex: 4296
P

MEXICO

Hewlett-Packard de Mexico, S.A.
Francisco J. Allan #30
Colonia Nueva
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Tel: 37220
P

Hewlett-Packard de Mexico, S.A.
Monti Morelos 299
Fraccionamiento Loma Bonita 45060
GUADALAJARA, Jalisco
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Telex: 0684 186 ECOME
P

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Microcomputadoras Hewlett-Packard, S.A.
Monti Pelvoux 115
LOS LOMAS, Mexico, D.F.
Tel: 520-9127
P

Hewlett-Packard Mexicana, S.A. de C.V.
Av. Periferico Sur No. 6501
Tepepan, Xochimilco
16020 **MEXICO D.F.**
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Telex: 17-74-507 HEWPACK MEX
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MEXICO D.F.
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P

Hewlett-Packard De Mexico, S.A. de C.V.
Czda. del Valle
409 Ote. 4th Piso
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Municipio de Garza Garcia
66220 **MONTERREY,** Nuevo León
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Telex: 038 410
P

MOROCCO

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81 rue Karatchi
B.P. 11133
CASABLANCA
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Telex: 23051, 22822
E

Gerep
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CASABLANCA 01
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Telex: 23 739
P

Sema-Maroc
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Telex: 5289 BROKER MB MUSCAT
P

Suhail & Saud Bahwan
P.O.Box 169
MUSCAT/SULTANATE OF OMAN
Tel: 734201
Telex: 5274 BAHWAN MB
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Imtac LLC
P.O. Box 8676
MUTRAH/SULTANATE OF OMAN
Tel: 601695
Telex: 5741 Tawoos On
A,C,M

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Cable: FEMUS Islamabad
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Mushko & Company Ltd.
Oosman Chambers
Abdullah Haroon Road
KARACHI 0302
Tel: 524131, 524132
Telex: 2894 MUSKO PK
Cable: COOPERATOR Karachi
A,E,M,P*

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Calle Samuel Lewis, Ed. Alfa
Apartado 4929
PANAMA 5
Tel: 64-2700
Telex: 3483 ELECTRON PG
A,CM,E,M,P

PERU

Cia Electro Médica S.A.
Los Flamencos 145, Ofc. 301/2
San Isidro
Casilla 1030
LIMA 1
Tel: 41-4325, 41-3705
Telex: Pub Booth 25306 PEC PISIDR
CM,E,M,P

SAMS
Arenida Republica de Panama 3534
San Isidro, LIMA
Tel: 419928/417108
Telex: 20450 PE LIBERTAD
A,C,P

PHILIPPINES

The Online Advanced Systems Corp
2nd Floor, Electra House
115-117 Esteban Street
Legaspi Village, Makati
P.O. Box 1510
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Tel: 815-38-10 (up to 16)
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PORTUGAL

Mundinter Intercambio
Mundial de Comércio S.A.R.L.
Av. Antonio Augusto Aguiar 138
Apartado 2761
LISBON
Tel: (19) 53-21-31, 53-21-37
Telex: 16691 munter p
M

Soquimica
Av. da Liberdade, 220-2
1298 **LISBOA** Codex
Tel: 56-21-82
Telex: 13316 SABASA
A

Telectra-Empresa Técnica de Equipmentos Eléctricos S.A.R.L.
Rua Rodrigo da Fonseca 103
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Computer Arabia
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P

Nasser Trading & Contracting
P.O.Box 1563
DOHA
Tel: 422170
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M

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Abdul Ghani El Ajou Corp
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RIYADH
Tel: 40 41 717
Telex: 200 931 EL AJOU
P

SCOTLAND

See United Kingdom

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Societe Hussein Ayad & Cie.
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DAKAR
Tel: 32339
Cable: AYAD-Dakar
E

Moneger Distribution S.A.
1, Rue Parent
B.P. 148
DAKAR
Tel: 215 671
Telex: 587
P

Systeme Service Conseil (SSC)
14, Avenue du Parachois
DAKAR ETOILE
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CM

SOUTH AFRICA

Hewlett-Packard So Africa (Pty.) Ltd
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Hewlett-Packard Española S.A.
Crta. de la Coruña, Km. 16, 400
Las Rozas
E-**MADRID**
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41005 **SEVILLA**
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Telex: 72933
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Hewlett-Packard Española S.A.
Isabel La Catolica, 8
46004 **VALENCIA**
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Hewlett-Packard Sverige AB
Ostra Tullgatan 3
S-21128 **MALMÖ**
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C,P

Hewlett-Packard Sverige AB
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S-16393 **SPÅNGA**
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S-42132 **VÄSTRA-FRÖLUNDA** (Gothenburg)
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SUDAN

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KHARTOUM
Tel: 41184
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Hewlett-Packard (Schweiz) AG
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CH-4058 **BASEL**
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Hewlett-Packard (Schweiz) AG
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Case postale 365
CH-1217 **MEYRIN** 1
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Telex:27333 HPAG CH
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Hewlett-Packard (Schweiz) AG
Allmend 2
CH-8967 **WIDEN**
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SYRIA

General Electronic Inc.
Nuri Basha Ahnaf Ebn Kays Street
P.O. Box 5781
DAMASCUS
Tel: 33-24-87
Telex: 411 215
Cable: ELECTROBOR DAMASCUS
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Middle East Electronics
P.O.Box 2308
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DAMASCUS
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M

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Ing Lih Trading Co.
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TAIPEI 100
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A

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30 Patpong Ave., Suriwong
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Telex: 84439 Simonco TH
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Bangkok Business Equipment Ltd.
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P

TOGO

Societe Africaine De Promotion
Immeuble Sagap
22, Rue d'Atakpame
B.P. 4150
LOME
Tel: 21-62-88
Telex: 5304
P

TRINIDAD & TOBAGO

Caribbean Telecoms Ltd.
Corner McAllister Street &
Eastern Main Road, Laventille
P.O. Box 732
PORT-OF-SPAIN
Tel: 624-4213
Telex: 22561 CARTEL WG
Cable: CARTEL, PORT OF SPAIN
CM,E,M,P

Computer and Controls Ltd.
P.O. Box 51
66 Independence Square
PORT-OF-SPAIN
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Telex: 3000 POSTLX WG, ACCT LOO9O AGENCY 1264
A,P

Feral Assoc.
8 Fitzgerald Lane
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TUNISIA

Precision Electronique S.A.R.L.
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P

Tunisie Electronique S.A.R.L.
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Corema S.A.
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TUNIS
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E.M.A
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M

Teknim Company Ltd.
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E,CM

Saniva Bilgisayar Sistemleri A.S.
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ISTANBUL
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C,P

Best Inc.
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Emitac Ltd.
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Emitac Ltd.
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SALES & SUPPORT OFFICES

Arranged alphabetically by country

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